# Measuring the Sixth Extinction: what do mollusks tell us?

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## ABSTRACT

The International Union for Conservation of Nature (IUCN) is the premier global biodiversity conservation organization. Its *Red List* is a rigorous vehicle for assessing the conservation status of plant and animal species. However, although all animal and bird species recognized by IUCN have been evaluated, only a tiny fraction of invertebrates have been evaluated. As a measure of the numbers of extinct species (since around the year 1500) the *Red List* is probably quite accurate for birds and mammals, but severely underestimates the numbers for invertebrates. Nonetheless, molluscs stand out as the major group most severely impacted by extinction, with 297 of the 744 animal species listed as extinct in the third issue of the 2016 *Red List*. Here we review efforts to obtain a more realistic, albeit less rigorous, assessment of the numbers of extinct mollusk species. Our approach has been based on bibliographic research and consultation with experts, rather than following the highly detailed but restrictive IUCN *Categories and Criteria*. In 2009, this led to an assessment that 533 mollusk species were extinct, far more than the number on the *Red List*. In the present study we revisited this approach and here list 638 species as extinct, 380 as possibly extinct, and 14 as extinct in the wild, a total of 1,032 species in these combined categories, and more than twice as many as listed by IUCN in these categories. However, this approach only considers species for which information is available; it is therefore biased. In a study published in 2015 we developed an alternative approach, based on a random global sample of land snails, and estimated that 3,000–5,100 mollusk species have gone extinct. We review the main reasons for these extinctions: habitat destruction, impacts of introduced species, exploitation and collecting, and, potentially, climate change, and discuss relevant case studies. Oceanic island land snails, especially those of Pacific islands, have suffered the greatest proportion of the extinctions, with some species having gone extinct before being discovered and described scientifically. The Amastridae, an endemic Hawaiian family of 325 recognized species, may have lost all but 18 species. We outline the phases in this catastrophe: 1) pre-human and/or prehistoric extinction, either natural or anthropogenic, with species known only as fossils/subfossils; 2) extinction due to habitat destruction and introduction of a number of alien species by Pacific island people as they settled the islands; 3) extinction due to extensive habitat destruction and introduction of highly destructive invasive alien species following colonization by Westerners; 4) extinction following the advent of large-scale agriculture at the end of the 19th Century, at the time of a major increase in the land snail extinction rate globally; 5) extinction due to increased military activity, tourism, commerce, urbanization and the concomittant rapidly increasing introduction of invasive species after the Second World War. Extrapolating from our assessments of mollusks, we estimate that approximately 7.5–13% of all species have gone extinct since around year 1500. This is orders of magnitude greater than the 860 (0.04% of 2 million) listed as extinct by IUCN (2016). The biodiversity crisis is real.

*Additional Keywords:* Amastridae, biodiversity crisis, bivalves, *Euglandina*, Gambier Islands, Hawaii, IUCN, *Melanopsis*, Mollusca, non-marine, *Powelliphanta*, *Rhachistia aldabrae*, *Red List*, snails

## INTRODUCTION

Over a decade ago, Lydeard et al. (2004) published a key paper outlining the decline of non-marine mollusks, the threats they face, and the high level of extinction compared with other major animal groups that had been documented as of 2002 by the International Union for Conservation of Nature on its *Red List*. The *Red List* program was initiated in 1964 and mollusks were first included in it in 1983, when 28 species were listed as extinct (Wells et al., 1983). The *Red List* only considers extinctions in modern historical times, from around the year 1500. Following the realization that an ill-conceived biological control program had caused the extinction in the wild of the entire fauna of partulid tree snails on the island of Moorea in French Polynesia (Murray et al., 1988), more effort was put into documenting mollusk extinctions on the *Red List*. A Moorean partulid appeared on the front cover of the 1990 *Red List* (IUCN, 1990), and when the 1994 *Red List* (Groombridge, 1994) was published, 255 species were listed as extinct. The number has gradually increased and the most recent *Red List* (IUCN, 2016) lists 297 mollusks as Extinct out of a total of 860 extinct species listed.

If we accept a figure of 2 million described species (Chapman (2009) estimated 1.9 million, and IISE (2017) documents a current yearly increment of around 18,000 newly described species; the *Red List* accepts 1,736,081 species), this means that between one and two species have gone extinct per year since 1500, the year from which IUCN starts counting, or about 0.8 species extinctions per million species years (E/MSY). The background rate, based on the fossil record, is around 0.1–2.0 E/MSY (Ceballos et al., 2015). That the rate documented by IUCN is within the estimated range of the background rate has provided support for the suggestion by environmental skeptics (e.g., Lomborg, 2001) that there is no "Biodiversity Crisis", despite the views of many scientists and the media publicity surrounding the notion of the "Sixth Extinction", caused by human activities (Novacek, 2001; Leakey and Lewin, 1996). So the question becomes, is there really a crisis or is it a false or exaggerated claim by environmental activists and scientists with an arguably political agenda?

The key question to ask in trying to resolve this conflict is: how accurate really are the IUCN extinction data? This review summarizes the approaches that have been developed since the review of Lydeard et al. (2004) and that have attempted to begin to answer this question (Régnier et al., 2009, 2015a). It updates the assessments of Régnier et al. (2009) and reviews a case study of a Hawaiian land snail family, the Amastridae, that used these new approaches to obtain a realistic assessment of extinction (Régnier et al., 2015b).

## IS THE IUCN RED LIST APPROPRIATE FOR ASSESSING EXTINCTION RATE?

The IUCN has assessed 85,604 species (IUCN, 2016). This represents a huge amount of detailed work by dedicated biologists, but nonetheless represents only 4.3% of the total 2 million animal and plant species. Although a small sample of overall biodiversity, if it were a random sample, some confidence could perhaps be placed in its assessment of extinction rate. However, it is not a random but a highly biased sample.

IUCN (2016) estimated that there are 5,567 known mammal species and 11,121 known bird species, total 16,688, although Chapman (2009) estimated 5,487 and 9,990, total 15,477, probably a result of differing taxonomic treatments and estimation protocols. IUCN (2016) has assessed all mammal and bird species that it recognizes. Of these, only 849 (~ 5%) were placed in the IUCN category "data deficient", that is, they lacked sufficient information to assess their conservation status according to the *IUCN Red List Categories and Criteria* (IUCN, 2012). Thus, the number of extinctions (239) listed for mammals and birds by IUCN (2016) is probably quite accurate.

However, the situation is very different for invertebrates, which constitute > 95% of described animal diversity, about 1.31 million (IUCN, 2016) or 1.5 million species (1.36 million of Chapman (2009) extrapolated by an annual increment of 1%). Only 18,609 of these species have been assessed, 1.2% of the total, with 7,205 (39%) of these deemed data deficient. Why is this? There are two main reasons: 1) taxonomic bias, and 2) the related relative difficulty of obtaining adequate data to assess the conservation status of invertebrates compared to vertebrates according to the IUCN criteria.

### Taxonomic Bias

There are on average many specialists able to assess the conservation status of each mammal or bird species. As most mammal and bird species have been discovered and described, these specialists are primarily field biologists working on ecology, population biology, behavior, etc. In contrast, most invertebrate specialists are taxonomists or systematists (in the broad sense including those studying biogeography, phylogenetics, and the assessment of biodiversity), and most of these systematists each deal with tens to hundreds of species. There are roughly equal numbers of specialists focused on vertebrates, on plants and on invertebrates, yet plant species are roughly ten times, and invertebrates a hundred times, more numerous than vertebrates (Gaston and May, 1992; May, 2011).

This bias and the 100-fold greater relative number of vertebrate specialists compared to invertebrate specialists is reflected in the numbers of IUCN Species Survival Commission Specialist Groups focused on particular taxa: 73 for vertebrates and only 12 for invertebrates, with only one for the entire phylum Mollusca (Table 1). In contrast, many of the vertebrate Specialist Groups are focused on just one or a few species (e.g., African elephant, hyaenas, vultures, pelicans, etc.).

### IUCN Criteria

The IUCN criteria are detailed and complex. They include precise quantitative determinations of remaining numbers of individuals, life history details, area occupied,

**Table 1.** Number of IUCN Specialist Groups for animals.

| Vertebrates | No. of Groups | Invertebrates | No. of Groups |
|---|---|---|---|
| Mammals | 35 | Insects | 4 |
| Birds | 16 | Other arthropods | 3 |
| Reptiles/amphibians | 12 | Coral | 1 |
| Fish | 10 | Mollusks | 1 |
| | | Geography/habitat | 3 |
| **Total** | **73** | **Total** | **12** |

trends in abundances and range and many other parameters that are precisely defined. This detail and precision was developed by IUCN in response to criticism that its assessments were too qualitative and subjective, indeed secretive (e.g., Mrosovsky, 1997). All mammal and bird species have been evaluated based on these stringent criteria, with very few species considered Data Deficient. This has been possible because, as explained above, there are many specialists in the field generating the kind of data that are required.

In contrast, for the great majority of invertebrate species, few data relevant to the IUCN criteria exist other than what are available in the original descriptions (type localities and little else) and perhaps a small number of subsequent publications. Most of the field research of any relevance is undertaken as part of biodiversity inventories, the discovery and subsequent description of the vast number of species as yet unknown to science, or indeed to humanity.

## MOLLUSKS ASSESSED BY IUCN

The most careful estimate of the number of described mollusk species (Rosenberg, 2014) suggested that there are 70,000–76,000, although IUCN (2016) estimated 85,000, following Chapman (2009). Compared to other invertebrate groups, a relatively high proportion of mollusk species has been assessed: 7,276 species (IUCN, 2016), or roughly 8.5–10%. However, in contrast to mammals and birds, a high proportion of these species was assessed as Data Deficient (2,463 species, 34%), for lack of adequate information addressing the IUCN criteria.

The *Red List* (IUCN, 2016) lists 860 species (744 animals, 116 plants) as Extinct, including 297 mollusk species. Mollusks, despite the small proportion of them that has been assessed, thus represent 35% of all species extinctions and 40% of animal extinctions, as reported by IUCN.

## ALTERNATIVE APPROACHES TO ASSESSING MOLLUSK EXTINCTIONS

### Régnier et al. (2009)

Given the shortcomings of the *Red List* in assessing the level of extinction of invertebrates overall, alternative approaches have been sought. Régnier et al. (2009) re-evaluated mollusk species listed as Extinct on the *Red List* of 2007 based on a review of the literature and by asking a cadre of biologists with expert knowledge to provide their opinion on the veracity of the *Red List* assessments. This literature review and gathering of expert knowledge also identified additional species not on the *Red List* but either documented in the literature as extinct or simply known to the experts as extinct. Some of the species listed as extinct were considered in fact not to be so, either because they had been found alive since being listed, or because they had been synonymized with extant species; and two species were excluded as being *nomina dubia*. Despite this reduction, from 302 species listed to 269 considered in fact to be extinct, overall the number of species considered extinct (both listed and not) increased to 533, including those considered Extinct in the Wild (13) and those considered "possibly extinct" (71) (Régnier et al., 2009: Supporting Information online), roughly twice as many as correctly considered Extinct on the *Red List*. Régnier et al. (2009) also listed 33 subspecies (including 5 extinct in the wild and 1 possibly extinct), for a total of 566 taxa.

### Update of Régnier et al. (2009)

Following the same approach as that of Régnier et al. (2009), i.e., literature search and expert consultation (see the Acknowledgements for the names of the experts who provided information), we have updated the list of species considered extinct. We took the most recent evaluation of each species as representing its current status, which was either the most recent IUCN evaluation as listed in the *Red List* (IUCN, 2016), Régnier et al. (2009), or our own literature/expert consultation. We excluded species listed as Extinct, Possibly Extinct, or Extinct in the Wild on the *Red List* and/or by Régnier et al. (2009) if they are now thought to be extant (Appendix Table A1). We also did not consider subspecies, neither those recognized in the *Red List* nor those listed by Régnier et al. (2009). Subspecies and synonyms that have been recognized in the literature subsequently but that are still retained as valid species on the *Red List*, as well as undescribed species listed with provisional names on the *Red List*, were also excluded (Appendix Table A2).

Of the 297 species listed as Extinct on the *Red List*, we considered six as now only Possibly Extinct, three as Extinct in the Wild, 20 as extant, and 11 that have now been considered synonyms, subspecies, *nomina dubia*, or unrankable. Of the 124 listed as "Critically Endangered (Possibly Extinct)" on the *Red List*, three are known to be extant, six are considered as now extinct, with a further five (Galapagos *Bulimulus* species) undescribed, five synonymized, and five unrankable. And of the 14 listed as extinct in the wild, we considered one to be extant in the wild and five to now be extinct. Thus, excluding undescribed species and species still listed as valid on the *Red List* but that have been synonymized, reduced to subspecies, considered unrankable, or are now thought to be extant, the current *Red List* (IUCN, 2016), in our view correctly lists 386 valid species in the combined categories of Extinct, Critically Endangered (Possibly Extinct), and Extinct in the Wild, which is 44 species fewer than the 430 actually listed by IUCN (Table 2).

The additional information derived from the literature search and expert consultation allowed us to estimate that in fact 638 species are extinct, 380 possibly extinct (EX?), and 14 extinct in the wild, a total of 1,032 species in the combined categories (Appendix Tables A3–5).

**Table 2.** Numbers of mollusk species considered extinct (EX), critically endangered (possibly extinct) (CR(PE)), and extinct in the wild (EW) in the *Red List* (IUCN, 2016), with species on the *Red List* re-assessed herein, and the results of the present study based on additional literature search and expert consultation.

| IUCN category | *Red List*[1] | *Red List* re-assessed | This study[2] |
|---|---|---|---|
| EX | 297 | 268 | 646 |
| CR(PE) / EX?[3] | 119 | 107 | 373 |
| EW | 14 | 11 | 14 |
| **Total** | **430** | **386** | **1,032** |

[1]Includes 11 fossil/subfossil species listed as extinct
[2]Includes 46 fossil/subfossil species listed as extinct
[3]CR(PE) in the *Red List*, EX? in this study

Of these, 47 are known only as "fossil" or "subfossil" but in many of these cases it was not possible to say when they went extinct, perhaps in some cases from natural causes such as non-anthropogenic climate change. For comparability with the approach officially taken by IUCN of focusing on species that have gone extinct since around the year 1500 (though 11 fossil/subfossil species are included in the *Red List*), we might conservatively exclude the 47 fossil/subfossil species in our list and then would consider 591 species as extinct, 380 as possibly extinct, and 14 as extinct in the wild, total 985 species. Even so, our numbers of extinct and possibly extinct species both greatly exceed those of the *Red List*, by more than two and three times respectively. This total is also approximately double the number listed by Régnier et al. (2009).

Of the 1,032 species (Appendix Tables A3–5), 803 are land snails, from 52 families but dominated by species of four Pacific island families, the Amastridae (307 species), which is a Hawaiian endemic family (see below), Endodontidae (92 species), Partulidae (52 species) and Achatinellidae (44 species), as well as one more widespread family (though with greatest diversity in the Pacific), the Charopidae (54 species). Freshwater snails are represented by 177 species from 22 families, with all but two families (Hydrobiidae, 61 species; Pleuroceridae, 32 species) represented by 12 or fewer species. Freshwater bivalves are represented by 46 species from five families, with only the Unionidae (40 species) having more than one or two species. Six marine gastropods are listed.

### Régnier et al. (2015)

Régnier et al. (2009) and the updated assessment provided above, have only dealt with species already assessed by IUCN and those additional species that were known to be extinct, possibly extinct, or extinct in the wild, both documented in the literature and as known to biologists with expert knowledge. These species were therefore not a random sample. A more realistic estimate of the true number of mollusk extinctions would only be provided by assessing a random sample of mollusk species.

Therefore, Régnier et al. (2015a), focusing on land snails, generated a rigorously random sample of 200 species from a wide representation of localities across the globe. They evaluated these species based on the IUCN categories and criteria (IUCN, 2012) by reviewing the literature as well as major museum collections. For comparison with this IUCN-based evaluation, they also sent the list of 200 species to numerous land snail experts, asking them to evaluate whether those species for which they had personal knowledge and experience were extinct. For species for which no expert was available, Régnier et al. (2015a) made their own assessment based on collection records. In addition, Régnier et al. (2015a) developed a mathematical probabilistic model, based on collection dates as documented in major museum malacological collections. This model evaluated the probability of extinction for each of the 200 species, and thereby offered an independent means of corroboration (or not) of the expert evaluation.

Based on the IUCN categories and criteria, Régnier et al. (2015a) were only able to evaluate 31 of the 200 species, the other 169 being categorized as Data Deficient. Of the 31, three (1.5% of the 200, but 10% of the evaluated 31) were evaluated as extinct. Under the assumptions that the 200 land snail species in the random sample are representative of the described non-marine molluscan diversity—roughly 30,000 species (Rosenberg, 2014)—and that marine molluscan extinction is negligible compared to non-marine extinction (e.g. Carlton, 1993; but see Peters et al., 2013), extrapolation leads to an estimate of 3,000 extinct mollusk species.

In contrast, the experts were able to evaluate 118 of the 200, the remaining 82 being "Impossible to Assess". Twenty (10% of the 200, but 17% of the evaluated 118) were evaluated as extinct. Note that Régnier et al. (2015a) used slightly different terminology from the IUCN categories in order to draw attention to the differences between the two approaches. The probabilistic model broadly corroborated the expert evaluations in terms of the proportion of species considered extinct.

Of the 76,000 described mollusk species (Rosenberg, 2014), about 46,000 are marine (WoRMS, 2017) and roughly 30,000 non-marine. Therefore, as 10–17% of the 200 land snail species were considered extinct, extrapolation suggests that in fact around 3,000–5,100 mollusk species are extinct, far more than the 297 on the *Red List* (IUCN, 2016), the 532 estimated by Régnier et al. (2009), the 1,032 estimated above updating Régnier et al. (2009), but in the same region as the 3,000 extrapolated from the assessments of Régnier et al. (2015a) based on the IUCN categories and criteria. This estimate of 3,000–5,100 mollusk extinctions, even taking into account that it is based on a small sample, is shocking. And many are going extinct before they have been discovered and described (e.g., Richling and Bouchet, 2013; Sartori et al., 2013; 2014).

## WHY ARE NON-MARINE MOLLUSKS GOING EXTINCT?

There are at least four possible causes of non-marine mollusk extinction, which are, for the most part, the same causes of the extinction of non-marine species in general: habitat destruction, impacts of introduced species, exploitation and collecting, and, potentially, climate change.

### Habitat Destruction

Urbanization, deforestation, agricultural expansion and exploitation of natural resources have all had impacts on mollusks. Three examples serve to illustrate some of these threats.

**Gambier Island Land Snails:** Based on collections made by the Bishop Museum (Honolulu) Mangarevan Expedition in 1934 and by the Muséum national d'Histoire naturelle (Paris) in 1997, 46 endemic species have been recorded from the Gambier Islands in the families Euconulidae, Endodontidae, Assimineidae, and Helicinidae (Abdou and Bouchet, 2000; Bouchet and Abdou, 2001; 2003; Richling and Bouchet, 2013). Only three of these species were still extant; the remainder were described from empty shells collected from the shell bank of the soil.

The cause of the extinction of almost this entire fauna was deforestation (Richling and Bouchet, 2013). Deforestation began with the first arrival of Polynesian settlers around 1,000 years ago and reached a peak in the 17th and 18th centuries with the total destruction of the native flora (Conte and Kirch, 2008), no doubt exacerbated after the arrival of Europeans in the early 19th Century. A few of the snail species were still extant in the 1840s–1860s, but no living specimens of all but the three known to be extant have been collected since the 19th Century (Richling and Bouchet, 2013). Similar scenarios have played out across the islands of the Pacific.

***Melanopsis parreyssii* in Romania:** This freshwater species was listed as Critically Endangered on the *Red List* in 2013 (Fehér, 2013). It was deemed Extinct in the Wild in 2016 (Sîrbu and Benedek, 2016). It was extremely narrowly endemic in Romania but had also been introduced to Hungary and Bulgaria. However, by 2010 these introduced populations had vanished (Fehér, 2013; Sîrbu et al., 2013). The Romanian locality was part of a system sustained by a geothermal aquifer that was declared a nature reserve and a Natura 2000 Site of Community Importance. There were lakes and creeks fed by thermal springs, forming the only habitat of *Melanopsis parreyssii*. However, rapidly increasing recent development of the geothermal waters, especially for tourism, led to the springs becoming clogged and the natural thermal lakes diminished, up to the point where the only natural, but shrinking, lake that remained was Peţea (referred to as Băile Episcopiei by Fehér, 2013). By 2011 the spring serving Peţea Lake ceased activity and by 2015 the lake had become little more than a puddle supporting no mollusks except an invasive bivalve (Sîrbu et al., 2013; Sîrbu and Benedek, 2016). Captive breeding efforts have met with little success (Sîrbu and Benedek, 2016). Human greed and disregard for the environment, including laws supposedly protecting it, had led to the destruction of the habitat of this narrowly endemic species and thus its extinction.

***Powelliphanta augusta* in New Zealand:** *Powelliphanta* species are large predatory, worm-eating land snails endemic to New Zealand and most have very small ranges, making them highly vulnerable to habitat destruction (Walker et al., 2008; Boyer et al., 2013). A species of *Powelliphanta*, first collected in 1996 but not recognized as a possible new species until 2003, and confirmed as such by Trewick (2005), was discovered on Mount Augustus, a peak on the Stockton Plateau in New Zealand's South Island and the site of a large open cast coal mine (Trewick et al., 2008). By 2003, much of the snails' habitat had been destroyed, with the entire remaining 8.5 ha of ridge-top habitat under severe threat from the mining. With this imminent threat, and following legal action (see Walker et al., 2008; Boyer et al., 2013), all snails and eggs that could be found were collected and brought into captivity, beginning in 2006. Soon thereafter, all but a tiny piece of snail habitat was destroyed (Walker et al., 2008). Many of the snails were transferred back to the wild at three sites with supposedly similar habitat, but the mortality rate in these populations was such that they were unlikely to survive (Morris, 2010). One of these sites was created by transferring entire habitat from the original site to an area not slated to be mined, but the large trees did not survive well and the habitat was invaded by weedy species (Morris, 2010). The captive snails exhibit slower growth and higher hatchling mortality than estimated in the original wild population (James et al., 2013). Furthermore, a large proportion of the captive snails died following an electrical malfunction in their temperature-controlled facility (James et al., 2013). The species was described as *Powelliphanta augusta* in 2008 (Walker et al., 2008). Although *P. augusta* is not yet extinct, the destruction of its entire habitat by coal mining has left it on the brink.

### Impacts of Introduced Species

It is generally difficult to demonstrate definitively that an invasive species has caused the extinction of another species. For example, following the zebra mussel (*Dreissena polymorpha*) invasion of North America beginning around 1985, many of the native freshwater mussels (Unionoida) were thought to be doomed (Ricciardi et al., 1998). At localities with high densities of *D. polymorpha*, local populations of native mussels were being extirpated and some of the native species were in steep decline or becoming regionally extinct. Over 60 species were thought to be in danger of global extinction from the combined effects of zebra mussels and habitat degredation (Ricciardi et al., 1998). However, a decade later, Strayer and Malcom (2007), focusing on four species in the Hudson River, showed that although they had declined steeply following zebra mussel invasion, by 2000–2004 populations of these species had stabilized at 4–22% of their pre-invasion densities, offering a slender hope that the native mussels might be able to co-exist with the invaders, albeit at much lower densities (Strayer and Malcom, 2007).

In contrast, the prime example of an invasive species causing extinction of mollusk species is the introduction of the predatory snail *Euglandina rosea* to the islands of the Pacific, notably to the Hawaiian Islands and the Society Islands of French Polynesia but also elsewhere (e.g., Cowie and Cook, 2001), in poorly considered efforts to control the invasive giant African snail, *Achatina fulica* (Hadfield, 1986; Murray et al., 1988). The clearest evidence of a direct impact was that as *E. rosea* spread across the island of Moorea, the endemic *Partula* tree snail species vanished in its wake; it did not control *A. fulica* (Murray et al., 1988; Cowie, 2001). On the other islands of the Society group the same story played out (Coote and Loève, 2003; Gerlach, 2016).

In Hawaii, the combination of *E. rosea* and invasive rats, following on from habitat destruction, has caused the decline of endemic achatinelline tree snails (Hadfield et al., 1993), and another introduced predatory snail, *Oxychilus alliarius*, may yet impact endemic Hawaiian species, notably the single species in the endemic monotypic helicarionid genus *Kaala* (Curry et al., 2016). The invasive predatory flatworm *Platydemus manokwari* has caused the extinction of endemic Pacific island snails, notably in the Ogasawara Islands (Chiba and Cowie, 2016). Competition between invasive and native snails may also be important, but no definitive instances of this have been documented (Cowie, 2005).

The impacts of invasive species are often inextricably linked to those of habitat destruction or modification, as invasive species, such as rats (e.g., Athens, 2009), may drastically alter habitat, and habitat alteration may facilitate the spread of invasive species (Didham et al., 2007). As such, they can be at least the partial cause of extinction. However, invasive species may act in concert with or consecutively with habitat alteration, making it difficult, with some clear exceptions, to say that invasive species, per se, have been the cause of specific mollusk species extinctions.

### Exploitation and Collecting

Numerous non-marine mollusk species are exploited for human consumption. In Europe, and especially in countries bordering the Mediterranean, various of the larger species of land snails are collected and eaten, most notably *Helix pomatia*, the "escargot de Bourgogne", and *Cornu aspersum*, the "petit gris", both of which are readily available in most French markets, but also more widely. However, although *C. aspersum* remains abundant and widespread in western Europe, *H. pomatia* has declined, notably in France, and efforts are increasingly being made to culture it for export, especially in eastern Europe (Ligaszewski et al., 2007). Nonetheless, *H. pomatia* is listed as of Least Concern on the *Red List* (IUCN, 2016). Various other species are eaten around the Mediterranean (Yildirim et al., 2004) but none seems to have attracted conservation concern. The collection in the wild for the restaurant trade, in combination with habitat loss and alien species, has endangered the endemic "bulimes" (genus *Placostylus*) of New Caledonia (Brescia et al., 2008; Neubert et al., 2009). In Asia, various species of Ampullariidae, Viviparidae, and Pachychilidae in particular are eaten, as are a number of clams and mussels (e.g., Köhler et al., 2012), and Achatinidae are eaten in West Africa (e.g., Nyoagbe et al., 2016); but none of these species has attracted great concern because of this.

There are a few records of land snails being used for medicinal purposes, e.g., *Theba pisana* (Benítez, 2011) and *Achatina fulica* (Cowie and D.G. Robinson, 2003), and religious purposes, e.g., *Achatina fulica* (Neto et al., 2012), and they may be a significant part of local rural economies (Osemeobo, 1991); they may also be introduced beyond their native range for such religious purposes (Vázquez et al., 2016). But there is no evidence that these usages have led to the decline and certainly not extinction of these species.

In the 19th Century, freshwater mussels (Unionida) were commercially harvested for their pearls, notably in the United States; over-harvesting led to decline of the populations and the fishery was largely abandoned (Neves, 1999; Anthony and Downing, 2001). However, soon thereafter, the demand for shells of freshwater mussels for the button industry burgeoned, causing further declines and adding to the already serious and increasing threats from habitat degredation; but this industry essentially died out with the advent of plastics (Neves, 1999; Anthony and Downing, 2001; Strayer et al., 2004), although it persists in other parts of the world (Beasley, 2001). However, the discovery in Japan that mussel shell material could act as nuclei for the production of cultured pearls, resulted in a further phase of exploitation of mussels in the United States for export, although demand declined drastically by the late 1990s (Neves, 1999) Although habitat degredation has been generally considered the primary cause of mussel decline, over-exploitation has also been important (Strayer et al., 2004).

The hobby of shell-collecting is generally more focused on marine than on non-marine species, with some marine taxa, for instance in the genus *Conus*, threatened as a result (Peters et al., 2013). Nonetheless, among non-marine species there are a few notable instances in which shell collecting and ornamental use may have been at least in part responsible for the decline and perhaps extinction of certain species (Cowie, 2004). Most notably, collecting of snails by late 19th and early 20th Century shell collectors quite possibly had an important impact on some of the larger and more colorful Hawaiian species, primarily but by no means exclusively the beautifully colored and patterned Achatinellinae

(Hadfield, 1986). Compared to marine species, there is a much more limited collectors' trade in shells of non-marine species, which nonetheless may lead to endangerment. However, the legal instruments of control (notably the Convention on International Trade in Endangered Species (CITES)) list only three non-marine gastropod genera: the genus *Achatinella*, with 39 species listed as Extinct or Critically Endangered by IUCN (2016), the genus *Polymita*, with no species listed, and *Papustyla pulcherrima*, the Manus Island (off the north coast of New Guinea) green tree snail, which is listed as Near Threatened by IUCN (2016) (see also Whitmore, 2016). The collection of the 10,000 or so shells of the partulid tree snail *Eua zebrina* that once made up the chandeliers in the lobby of American Samoa's then main hotel surely must have significantly reduced at least some populations of that species (Cowie, 1993).

Overall, therefore, exploitation and collecting have not been a major cause of mollusk extinction, with a number of notable exceptions.

### Climate Change

Gerlach (2007) declared that *Rhachistia aldabrae*, an endemic cerastid from Aldabra Atoll that was still locally abundant in the 1970s (Gerlach, 2009), had gone extinct in the late 1990s as a result of declining rainfall. It was therefore placed on the *Red List* as Extinct (Gerlach, 2009). This is the only instance of a mollusk being reported as having gone extinct as a result of climate change. However, in 2014 it was discovered alive (Battarbee, 2014). Nonetheless, there is only one tiny population (J. Gerlach, pers. comm.) and it seems likely that with ongoing climate change it may yet succumb. The *Red List* (IUCN, 2016) has not yet been updated.

Baur and Baur (1993) concluded that the local extirpation of the widespread European land snail *Arianta arbustorum* at sites around the city of Basel, Switzerland, had resulted from climate warming in otherwise suitable areas close to extensive urban development, and that sites from which *A. arbustorum* had disappeared had higher surface temperatures than sites where it remained. The same authors (Baur and Baur, 2013) compared historical records from 1916–1917 with survey results from 2011–2012 on nine mountain slopes in Switzerland. They found that the upper elevational limit for *A. arbustorum* had risen 164 m in the 95 year period, during which mean annual temperature in the area had risen 1.6 °C. Although only a local impact, this study demonstrated the potential for climate change to affect populations of land snails.

Similarly, Pearce and Paustian (2013) undertook extensive elevational surveys in Pennsylvania, USA, to assess whether, with climate warming, species forced ever upward would eventually have nowhere further to retreat to (cf. similar studies on arthropods: Meyer et al., 2015). Of the 69 species recorded, five appeared especially susceptible. This kind of susceptibility is of particular concern on oceanic islands, especially in the Pacific. On many Pacific islands, habitat destruction and the introduction of invasive species at lower elevations has resulted in most of the remaining endemic land snail species being confined to higher elevation refugia (Durkan et al., 2013), either because their lower elevation populations have been extirpated or because they are evolutionarily adapted to the lower temperatures at these higher elevations and historically only ever occurred there. As such, with limited opportunity to move to higher elevations as the climate warms, they face extinction.

Thus, there is no evidence that climate change has caused the extinction of any non-marine mollusk species. However, continued warming will probably have more serious effects in the future, and ocean acidification resulting from raised carbon dioxide levels may impact marine species (Peters et al., 2015).

## EXTINCTION ON PACIFIC ISLANDS: A CASE STUDY

Among the species assessed as extinct by Régnier et al. (2009), more than 70% were from oceanic islands and most of these were from the Hawaiian Islands, French Polynesia and the Mascarene Islands. Previous authors have suggested that 65–90% of the Hawaiian land snail species have gone extinct (Solem, 1990; Cowie and A.C. Robinson, 2003; Lydeard et al., 2004). The proportion differs among families, but three groups (Achatinellinae, Amastridae, Endodontidae) appear to have suffered "catastrophic extinction" (Solem, 1990; and see above).

To begin to get a more accurate assessment of the level of extinction in Hawaiian land snails, Régnier et al. (2015b) focused on the Amastridae, a family endemic to the Hawaiian Islands and with 325 known valid species (Cowie et al., 1995). Rather than using the rigid IUCN categories and criteria (IUCN, 2012), they took a less rigorous approach similar to that taken by Régnier et al. (2015a). They based their assessments on a comparison of information from historical collections and archived field notes in the Bishop Museum, with data from modern extensive surveys undertaken throughout the Hawaiian Islands by K.A. Hayes, N.W. Yeung, and collaborators between 2004 and 2013. They also consulted a diversity of experts with experience in the Hawaiian land snail fauna. A species was considered extinct if it had not been found since 2004 at any recently surveyed location where it had formerly been recorded. In addition, and again taking a similar approach to that adopted by Régnier et al. (2015a) in order to provide independent corroboration, Régnier et al. (2015b) undertook a statistical assessment of extinction probabilities, based on collection years and using the methods of Thompson et al. (2013) and Lee (2014).

Of the 325 species, 131 were assessed as extinct; there was insufficient evidence of extinction for 179, although most of these can probably be considered extinct (and were considered possibly extinct in the updated analysis of global extinctions, above); but only 15 were considered definitively extant (three subsequently found extant; N.W. Yeung and K.A. Hayes, pers. comm.). Thus, a minimum of 131 (40%) and maximum 310 (95%) were considered extinct. The probabilistic assessment was consistent with the expert assessment: the probabilities of being extant for those species assessed as extinct was <0.01 (111 species), <0.1 (16 species) and 0.1–0.3 (4 species); and for those species assessed as extant it was 0.38–0.93 (15 species); the species for which there was insufficient evidence of extinction were not assessed probabilistically. The *Red List* (IUCN, 2016) lists only 33 amastrid species (10%) as extinct.

There have been five phases of amastrid extinction, discussed in more detail by Régnier et al. (2015b), as follows.

1) Description as fossils or subfossils and not known to be extant, but it is not possible currently to determine when they went extinct, i.e., prior to or after human colonization of the Hawaiian Islands, or prior to or after around the year 1500.
2) Subsequent to the first colonization of the islands by Polynesians, 800–1000 years ago, which led to considerable habitat destruction and introduction of a number of alien species.
3) Following European colonization, when extensive additional habitat destruction took place and highly destructive invasive alien species were introduced.
4) Following the advent of large-scale agriculture at the end of the 19th Century, at the time of a major increase in land snail extinction rate globally, identified as around 1895 by Régnier et al. (2015a).
5) After 1945 and the end of the Second World War, with the increased military activity, tourism, commerce, urbanization and rapidly increasing introduction of invasive species, including snails (Cowie, 1998).

If the extinction rate were constant over this roughly 1,000 year period, it would have been between roughly 0.4 and 1.0% of the fauna per decade, given the extremes of 131 and 310 of the 325 amastrid species having gone extinct. However the rate was certainly not constant but probably has increased in a roughly exponential and step-wise manner over time. Régnier et al. (2015b) therefore modeled a number of scenarios reflecting this increasing rate. The overall rates obtained ranged from 0.4% of the amastrid fauna per decade (131 species extinct, beginning in the year 1000, as above) to 14% per decade (310 species extinct, beginning in 1945). These scenarios are certainly over-simplistic, but nonetheless provide a framework for discussion.

## DISCUSSION

The most conservative estimate of 0.4% per decade for the Hawaiian amastrid extinction rate is similar to the global biodiversity extinction rate of < 1% per decade estimated by Costello et al. (2013). However, this extinction rate is probably not reflective of the true rate of amastrid extinction, as not only is it based on a very conservative estimate of the number of species that have gone extinct (131) but it assumes a constant rate since the year 1000. Undoubtedly, the rate has increased over the millenium and Régnier et al. (2015b) suggested that a rate of around 5% per decade over the last 150–200 years would be more realistic, indeed still rather conservative, given the maximum rate they estimated of 14% per decade. A rate of 5% would lead to a loss of > 50% of a fauna within 150 years (Costello et al., 2013). Indeed, for the amastrids, with only 18 of 325 species known to be extant (i.e., including the three species discovered alive since Régnier et al., 2015b; see above), this scenario seems to have already played itself out.

This rate (5% per decade) is much higher than the global estimate of the loss over the last 500 years or so of 3,000–5,100 (10–17%) of the 30,000 known land snail species, as estimated by Régnier et al. (2015a) and outlined above. The amastrids, however, may be an extreme case, although land snail groups from other Pacific islands have suffered similar fates, notably the Endodontidae (Solem, 1976; Zimmerman et al., 2009; Sartori et al., 2013; 2014) and Partulidae (Coote et al., 2003; Gerlach, 2016), and many extinct species continue to be found, as empty shells, even before their scientific description (e.g., Richling and Bouchet, 2013). Oceanic island biotas are in general much more susceptible to extinction than more buffered continental faunas (Triantis et al., 2010). And some taxa may be more susceptible than others. Therefore it may be dangerous to base generalizations regarding extinction rates on global estimates, though even these, such as the loss of 10–17% of land snail species in 500 years described here, are cause for great concern. While it is crucial to increase awareness of the high level of global extinction, subsuming more local extinction rates, especially of particularly susceptible faunas such as those of oceanic islands, or of particularly susceptible taxa such as the Amastridae, under global rates will doom those plants and animals to extinction as their special vulnerability and need for conservation will be overlooked, or at least not adequately appreciated.

If we assume that 1) the 200 land snail species sampled by Régnier et al. (2015a) are representative of known non-marine invertebrate diversity and their extinction rate, 2) three-quarters of species are non-marine (Mora et al., 2011), and 3) marine extinctions are negligible compared with non-marine extinctions (only four marine mollusks are considered as extinct; IUCN (2016), and see above), then approximately 7.5–13% of all species have gone extinct since around 1500. This is orders of magnitude greater than the 860 (0.05% of 2 million) listed as extinct by IUCN (2016). The biodiversity crisis is real.

But what of the IUCN? The studies reviewed herein have shown that it is inappropriate to use the IUCN *Red List* as a source of data on global extinction rates (except for mammals and birds), and more generally that assessing overall levels of threat to all biodiversity based on the species listed by IUCN seriously downplays that threat, notably because the great majority of biodiversity (invertebrates) has not been evaluated. A similar critique was voiced by Possingham et al. (2002), who argued that threatened species lists (such as the IUCN *Red List*) should not be used to indicate the overall status of biodiversity and changes in it, largely because of uneven taxonomic treatment and variation in observational effort (as described above for vertebrates compared to invertebrates). Nonetheless, IUCN is the premier and most influential global conservation organization. But its goal is to "highlight taxa threatened with extinction, and thereby promote their conservation" (IUCN, 2016); documenting extinction is incidental to this goal as once extinct a species cannot be conserved. For terrestrial vertebrates IUCN is well on the way to achieving its goal, but invertebrates present a daunting challenge both because of their immense diversity and because of the lack of adequate data to apply the IUCN criteria for the vast majority of them.

Major focused efforts by IUCN continue to be made to evaluate additional mollusk species (e.g., Seddon, 2011; 2014; 2015; Pippard, 2012; Peters et al., 2013; Seddon et al., 2014; Allen et al., 2016; Böhm and Allcock, 2016; Neubert et al., 2017). These efforts have focused on particular taxa, habitats and geographic locations that were deemed *a priori* as especially in need of attention, i.e., to address the IUCN goals of highlighting taxa in need of conservation (above), and for which funding could be obtained. Nonetheless, at the current rate it will be many years before all mollusks, or even all non-marine mollusks, have been assessed. The approach we have taken in the two studies reviewed herein (Régnier et al., 2015a, b), as well as our update of the analysis of Régnier et al. (2009) based on new information, is an attempt to speed up the evaluation process and to develop a method that allows global trends to be more realistically determined. Admittedly, our approach is less rigorous than the process of applying the IUCN criteria to assign species to the IUCN categories, with peer review required (when at best only one specialist has any knowledge of the fauna), but is considerably quicker and more cost-effective. While there is a chance that our approach might incorrectly list some species as extinct and thereby cut them off from conservation attention, it has the potential to identify many more species in need of conservation, species that would be listed as Data Deficient by IUCN and therefore also ignored. Our approach also has the advantage that it can provide a much more realistic overview of the biodiversity crisis than can the *Red List*, especially regarding the extraordinary levels of extinction, which was our immediate focus in the studies reviewed above. Nonetheless, IUCN remains the preeminent global conservation agency with a crucial role in identifying conservation needs and developing global conservation strategies. Our efforts do not in any way compromise those roles.

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# APPENDIX

**Table A1.** Species considered extinct, extinct in the wild or critically endangered (possibly extinct) by Régnier et al. (2009) and/or the *Red List* (IUCN, 2016) but now known or thought to be extant (or unrankable). DD – data deficient, VU – vulnerable, EN – endangered, CR – critically endangered, EW – extinct in the wild, EX – Extinct.

| Species | *Red List* | Régnier et al. | References indicating species is extant |
|---|---|---|---|
| ACHATINELLIDAE | | | |
| *Achatinella livida* Swainson, 1828 | EX | Extant | M.G. Hadfield, pers. comm. |
| *Auriculella uniplicata* (Pease, 1868) | EX | Extant | N.Y. Yeung, pers. comm. |
| *Perdicella fulgurans* Sykes, 1900 | EX | Extant | M.G. Hadfield, pers. comm. |
| *Perdicella maniensis* (Pfeiffer, 1856) | EX | Extant | M.G. Hadfield, pers. comm. |
| *Perdicella zebrina* (Pfeiffer, 1856) | EX | Extant | M.G. Hadfield, pers. comm. |
| CERASTIDAE | | | |
| *Rhachistia aldabrae* (Martens, 1898) | EX | EX | Battarbee, 2014 |
| CYCLOPHORIDAE | | | |
| *Cyclophorus horridulum* (Morelet, 1882) | EX | EX? | Abdou et al., 2004 |
| *Cyclosurus mariei* Morelet, 1881 | EX | – | Abdou et al., 2004 |
| HYDROBIIDAE | | | |
| *Belgrandiella zermanica* Radoman, 1973 | VU | EX | Slapnik and Lajtner, 2011 |
| *Bracenica spiridoni* Radoman, 1973 | EN | EX | Pešić, 2010a; Pešić and Glöer, 2013 |
| *Islamia zermanica* Radoman, 1973 | CR(PE) | EX | Beran et al., 2016 |
| *Marstonia castor* (Thompson, 1977) | CR | EX? | Johnson et al., 2013 |
| *Mercuria globulina* (Letourneux and Bourguignat, 1887) | EX | – | Glöer et al., 2015 |
| *Tanousia zrmanjae* (Brusina, 1866) | CR | EX | Beran, 2011; Falniowski, 2011a |
| *Vinodolia fiumana* Radoman, 1973 | EN | EX | Szarowska et al., 2013; Falniowski and Seddon, 2014 |
| *Vinodolia fluviatilis* (Radoman, 1973) | EN | EX | Beran, 2011; Falniowski, 2011b |
| *Vinodolia gluhodolica* (Radoman, 1973) | EN | EX | Pešić, 2010b; Glöer and Pešić, 2014 |
| LITHOGLYPHIDAE | | | |
| *Clappia cahabensis* Clench, 1965 | EX | – | Johnson et al., 2013 |
| *Somatogyrus alcoviensis* Krieger, 1915 | EX | – | Johnson et al., 2013 |
| *Somatogyrus amnicoloides* Walker, 1915 | EX | EX | "unrankable", Johnson et al., 2013 |
| *Somatogyrus crassus* Walker, 1904 | CR(PE) | – | "unrankable", Johnson et al., 2013 |
| *Somatogyrus currierianus* Lea, 1863 | CR(PE) | – | "unrankable", Johnson et al., 2013 |
| *Somatogyrus hendersoni* Walker, 1909 | CR(PE) | – | "unrankable", Johnson et al., 2013 |
| *Somatogyrus humerosus* Walker, 1906 | CR(PE) | – | "unrankable", Johnson et al., 2013 |
| *Somatogyrus nanus* Walker, 1904 | CR(PE) | – | "unrankable", Johnson et al., 2013 |
| LITTORINIDAE | | | |
| *Littoraria flammea* (Philippi, 1847) | EX | EX | Dong et al., 2015 |
| NEOCYCLOTIDAE | | | |
| *Incerticyclus martinicensis* (Shuttleworth, 1857) | EX | EX | Delannoye et al., 2015 |
| PARTULIDAE | | | |
| *Partula leefei* Smith, 1897 | – | EX | Gerlach, 2016 |
| *Partula nodosa* Pfeiffer, 1853 | EW | EW | Gerlach, 2016 |
| *Samoana annectens* (Pease, 1864) | DD | EX | Gerlach, 2016 |
| *Samoana diaphana* (Crampton and Cooke, 1953) | EN | EX | Gerlach, 2016 |
| *Samoana inflata* (Reeve, 1842) | EX | – | Gerlach, 2016 |
| PHYSIDAE | | | |
| *Physella columbiana* Keep, 1887 | – | EX? | Johnson et al., 2013 |
| *Physella hemphilli* Taylor, 2003 | – | EX? | Johnson et al., 2013 |
| PLANORBIDAE | | | |
| *Rhodacmea filosa* (Conrad, 1834) | CR | EX | Ó Foighil et al., 2011 |
| PLEUROCERIDAE | | | |
| *Elimia lachryma* (Reeve, 1861) | EX | – | Johnson et al., 2013 |
| *Elimia melanoides* (Conrad, 1834) | – | EX | Minton et al., 2003; Johnson et al., 2013 |
| *Elimia mutabilis* (Lea, 1862) | – | EX? | Johnson et al., 2013 |
| *Elimia troostiana* (Lea, 1838) | CR(PE) | – | Johnson et al., 2013 |
| *Elimia varians* (Lea, 1861) | VU | EX | Cordeiro and Perez, 2012 |
| *Elimia vanuxemiana* Lea, 1843 | EX | – | Johnson et al., 2013 |
| *Leptoxis compacta* (Anthony, 1854) | EX | EX | Whelan et al., 2012 |

(*Continued*)

**Table A1.** (cont.)

| Species | *Red List* | Régnier et al. | References indicating species is extant |
|---|---|---|---|
| *Leptoxis foremanii* (Lea, 1843) | EX | EX | Johnson et al., 2013 |
| STREPTAXIDAE | | | |
| *Gulella mayottensis* (Connolly, 1885) | EX | – | Abdou et al., 2004 |
| VIVIPARIDAE | | | |
| *Tchangmargarya yangtsunghaiensis* (Tchang and Tsi, 1949) | CR(PE) | – | Zhang et al., 2015 |
| UNIONIDAE | | | |
| *Pleurobema taitianum* (Lea, 1834) | EN | EX | Cummings and Cordeiro, 2012 |

**Table A2.** Species listed on the *Red List* (IUCN, 2016) or by Régnier et al. (2009) as extinct or critically endangered (possibly extinct) but now considered as subspecies or synonyms of other species, as *nomina dubia*, or that are undescribed. These are excluded from the present analysis.

| Species | *Red List* | Régnier et al. | Source for subspecies/synonym/ undescribed status |
|---|---|---|---|
| HYDROBIIDAE | | | |
| *Bythiospeum dubium* (Geyer, 1904) | CR(PE) | – | Synonym of *Bythiospeum acicula*; Richling et al., 2016 |
| *Bythiospeum gonostoma* (Geyer, 1905) | CR(PE) | – | Synonym of *Bythiospeum acicula*; Richling et al., 2016 |
| *Bythiospeum putei* (Geyer, 1904) | CR(PE) | – | Synonym of *Bythiospeum acicula*; Richling et al., 2016 |
| *Bythiospeum turritum* (Clessin, 1877) | CR(PE) | – | Synonym of *Bythiospeum acicula*; Richling et al., 2016 |
| *Pseudamnicola desertorum* (Bourguignat, 1862) | EX 2010 | – | Synonym of *Pseudamnicola letourneuxiana*; Glöer et al., 2010 |
| ORTHALICIDAE | | | |
| *Bulimulus* sp. nov. *'josevillani'* | CR(PE) | | undescribed; IUCN (2016) |
| *Bulimulus* sp. nov. *'krameri'* | CR(PE) | | undescribed; IUCN (2016) |
| *Bulimulus* sp. nov. *'nilsodhneri'* | CR(PE) | | undescribed; IUCN (2016) |
| *Bulimulus* sp. nov. *'tuideroyi'* | CR(PE) | | undescribed; IUCN (2016) |
| *Bulimulus* sp. nov. *'vanmoli'* | CR(PE) | | undescribed; IUCN (2016) |
| PARTULIDAE | | | |
| *Partula callifera* Pfeiffer, 1857 | EX | | Subspecies of *Partula dentifera*; Gerlach, 2016 |
| *Partula candida* Crampton, 1956 | EX | | Subspecies of *Partula dentifera*; Gerlach, 2016 |
| *Partula cedista* Crampton, 1956 | EX | | Subspecies of *Partula dentifera*; Gerlach, 2016 |
| *Partula citrina* Pease, 1866 | EX | | Subspecies of *Partula dentifera*; Gerlach, 2016 |
| *Partula formosa* Garrett, 1884 | EX | | Subspecies of *Partula dentifera*; Gerlach, 2016 |
| *Partula imperforata* Pfeiffer, 1877 | EX | | Subspecies of *Partula dentifera*; Gerlach, 2016 |
| *Partula raiatensis* Garrett, 1884 | EX | | Synonym of *Partula imperforata*; Gerlach, 2016 |
| PLEUROCERIDAE | | | |
| *Elimia timida timida* Goodrich, 1942 | – | EX | Dillon and Robinson, 2011 |
| UNIONIDAE | | | |
| *Nodularia cariei* (Germain, 1919) | EX 1996 | EX | Synonym of *Coelatura aegyptiaca*; Graf and Cummings, 2009 |
| *Unio madagascariensis* Sganzin, 1842 | EX 2016 | – | *Nomen dubium*; Graf and Cummings, 2009 |
| *Unio malgachensis* Germain, 1911 | EX 2016 | – | *Nomen dubium*; Graf and Cummings, 2009 |

**Table A3.** Terrestrial species considered extinct (EX), possibly extinct (EX?) or extinct in the wild (EW) in the present study, compared with their status as evaluated by Régnier et al. (2009), and on the *Red List* (IUCN, 2016). *Red List* categories are extinct (EX), extinct in the wild (EW), critically endangered (possibly extinct) (CR(PE)), critically endangered (CR), and data deficient (DD); the date of the IUCN evaluation follows the status. EX? is treated as equivalent to CR(PE). A dash indicates the species was not evaluated. Sources are only provided if the status in this study differs from the later of IUCN (2016) and Régnier et al. (2009). Species explicitly described as fossil or subfossil are asterisked.

| Species | Red List | Régnier et al., 2009 | This study | Source for revised status; comments |
|---|---|---|---|---|
| ACHATINELLIDAE | | | | |
| *Achatinella abbreviata* Reeve, 1850 | EX 1996 | EX | EX | |
| *Achatinella apexfulva* (Dixon, 1789) | – | – | EX? | B.S. Holland, pers. comm., 2016 |
| *Achatinella buddii* Newcomb, 1854 | EX 1990 | EX | EX | |
| *Achatinella caesia* Gulick, 1858 | EX 1990 | EX | EX | |
| *Achatinella casta* Newcomb, 1854 | EX 1990 | EX | EX | |
| *Achatinella cestus* Newcomb, 1854 | – | – | EX? | USFWS, 1993 |
| *Achatinella decora* (Férrusac, 1821) | EX 1990 | EX | EX | |
| *Achatinella dimorpha* Gulick, 1858 | EX 1990 | EX | EX | |
| *Achatinella elegans* Newcomb, 1854 | EX 1996 | EX | EX | |
| *Achatinella juddii* Baldwin, 1895 | EX 1996 | EX | EX | |
| *Achatinella juncea* Gulick, 1856 | EX 1996 | EX | EX | |
| *Achatinella lehuiensis* Smith, 1873 | EX 1990 | EX | EX | |
| *Achatinella papyracea* Gulick, 1856 | EX 1990 | EX | EX | |
| *Achatinella phaeozona* Gulick, 1856 | – | – | EX? | USFWS 1993 |
| *Achatinella rosea* Swainson, 1828 | – | – | EX | USFWS 1993 |
| *Achatinella spaldingi* Pilsbry and Cooke, 1914 | EX 1990 | EX | EX | |
| *Achatinella stewartii* (Green, 1827) | – | – | EX? | B.S. Holland, pers. comm., 2016 |
| *Achatinella thaanumi* Pilsbry and Cooke, 1914 | EX 1990 | EX | EX | |
| *Achatinella valida* Pfeiffer, 1855 | EX 1990 | EX | EX | |
| *Achatinella viridans* Mighels, 1845 | – | – | EX? | USFWS, 1993 |
| *Achatinella vittata* Reeve, 1850 | – | – | EX | USFWS, 1993 |
| *Achatinella vulpina* (Férrusac, 1821) | – | – | EX | USFWS, 1993 |
| *Auriculella expansa* Pease, 1868 | EX 1994 | EX | EX | |
| *Hotumatua anakenana* Kirch et al., 2009 | – | – | EX | Kirch et al., 2009 |
| *Lamellidea monodonta* (Pilsbry and Hirase, 1904) | EX 1994 | EX | EX | |
| *Lamellidea nakadai* (Pilsbry and Cooke, 1915)* | EX 1994 | – | EX | |
| *Newcombia canaliculata* (Baldwin, 1893) | – | – | EX | B.S. Holland, pers. comm., 2016 |
| *Newcombia gagei* Severns, 2009* | – | – | EX | Severns, 2009 |
| *Newcombia perkinsi* Sykes, 1896 | – | – | EX | B.S. Holland, pers. comm., 2016 |
| *Newcombia pfeifferi* (Newcomb, 1853) | – | – | EX | B.S. Holland, pers. comm., 2016 |
| *Newcombia philippiana* (Pfeiffer, 1857) | EX 1994 | – | EX | |
| *Newcombia sulcata* (Pfeiffer, 1857) | – | – | EX | B.S. Holland, pers. comm., 2016 |
| *Partulina variabilis* (Newcomb, 1854) | – | – | EW | |
| *Partulina confusa* (Sykes, 1900) | CR 1996 | EX | EX | |
| *Partulina crassa* (Newcomb, 1854) | EX 1986 | EX | EX | |
| *Partulina dubia* (Newcomb, 1853) | – | – | EX | B.S. Holland, pers. comm., 2016 |
| *Partulina horneri* (Baldwin, 1895) | – | EX | EX | |
| *Partulina montagui* Pilsbry, 1913 | EX 1986 | EX | EX | |
| *Partulina semicarinata* (Newcomb, 1854) | – | – | EW | |
| *Perdicella carinella* (Baldwin, 1906) | – | – | EX | B.S. Holland, pers. comm., 2016 |
| *Perdicella ornata* (Newcomb, 1854) | – | – | EX | B.S. Holland, pers. comm., 2016 |
| *Perdicella thwingi* (Pilsbry and Cooke, 1914) | – | – | EX | B.S. Holland, pers. comm., 2016 |
| *Perdicella zebra* (Newcomb, 1855) | EX 1994 | EX | EX | |
| *Tornelasmias capricorni* Iredale, 1944 | EX 1996 | EX | EX | |
| AMASTRIDAE | | | | |
| *Amastra abavus* Hyatt and Pilsbry, 1911) | – | – | EX? | Régnier et al., 2015 |
| *Amastra aemulator* Hyatt and Pilsbry, 1911) | – | – | EX? | Régnier et al., 2015 |
| *Amastra affinis* (Newcomb, 1854) | – | – | EX | Régnier et al., 2015 |
| *Amastra albocincta* Pilsbry and Cooke, 1914 | – | – | EX? | Régnier et al., 2015 |
| *Amastra albolabris* (Newcomb, 1854) | EX 1994 | EX | EX | Régnier et al., 2015 |
| *Amastra amicta* Smith, 1873 | – | – | EX? | Régnier et al., 2015 |

(*Continued*)

**Table A3.** (cont.)

| Species | Red List | Régnier et al., 2009 | This study | Source for revised status; comments |
|---|---|---|---|---|
| *Amastra anthonii* (Newcomb, 1861) | – | – | EX | Régnier et al., 2015 |
| *Amastra antiqua* (Baldwin, 1895)* | – | – | EX | Régnier et al., 2015 |
| *Amastra assimilis* (Newcomb, 1854) | – | – | EX | Régnier et al., 2015 |
| *Amastra aurostoma* Baldwin, 1896) | – | – | EX? | Régnier et al., 2015 |
| *Amastra badia* (Baldwin, 1895) | – | – | EX? | Régnier et al., 2015 |
| *Amastra baldwiniana* Hyatt and Pilsbry, 1911 | – | – | EX | Régnier et al., 2015 |
| *Amastra biplicata* (Newcomb, 1854) | – | – | EX? | Régnier et al., 2015 |
| *Amastra borcherdingi* Hyatt and Pilsbry, 1911 | – | – | EX? | Régnier et al., 2015 |
| *Amastra breviata* Baldwin, 1895) | – | – | EX? | Régnier et al., 2015 |
| *Amastra caputadamantis* Hyatt and Pilsbry, 1911* | – | – | EX | Régnier et al., 2015 |
| *Amastra conica* Baldwin, 1906* | – | – | EX | Régnier et al., 2015 |
| *Amastra conifera* Smith, 1873 | – | – | EX? | Régnier et al., 2015 |
| *Amastra cornea* (Newcomb, 1854) | EX 1994 | EX | EX | Régnier et al., 2015 |
| *Amastra crassilabrum* (Newcomb, 1854) | EX 1994 | EX | EX | Régnier et al., 2015 |
| *Amastra cyclostoma* (Baldwin, 1895) | – | – | EX | Régnier et al., 2015 |
| *Amastra davisiana* Cooke, 1908 | – | – | EX | Régnier et al., 2015 |
| *Amastra decorticata* Gulick, 1873 | – | – | EX? | Régnier et al., 2015 |
| *Amastra delicata* Cooke, 1933 | – | – | EX | Régnier et al., 2015 |
| *Amastra durandi* Ancey, 1897 | – | – | EX? | Régnier et al., 2015 |
| *Amastra dwightii* Cooke, 1933 | – | – | EX | Régnier et al., 2015 |
| *Amastra elegantula* Hyatt and Pilsbry, 1911 | – | – | EX? | Régnier et al., 2015 |
| *Amastra elephantina* Cooke, 1917* | – | – | EX | Régnier et al., 2015 |
| *Amastra elliptica* Gulick, 1873 | – | – | EX? | Régnier et al., 2015 |
| *Amastra elongata* (Newcomb, 1853) | EX 1996 | EX | EX | Régnier et al., 2015 |
| *Amastra eos* Pilsbry and Cooke, 1914 | – | – | EX? | Régnier et al., 2015 |
| *Amastra extincta* (Pfeiffer, 1856)* | – | – | EX | Régnier et al., 2015 |
| *Amastra farcimen* (Pfeiffer, 1857) | – | – | EX | Régnier et al., 2015 |
| *Amastra flavescens* (Newcomb, 1854) | – | – | EX | Régnier et al., 2015 |
| *Amastra flemingi* Cooke, 1917* | – | – | EX | Régnier et al., 2015 |
| *Amastra forbesi* Cooke, 1917* | EX 1996 | EX | EX | Régnier et al., 2015 |
| *Amastra fossilis* Baldwin, 1903* | – | – | EX | Régnier et al., 2015 |
| *Amastra fragilis* Pilsbry and Cooke, 1914 | – | – | EX? | Régnier et al., 2015 |
| *Amastra fragosa* Cooke, 1917 | – | – | EX? | Régnier et al., 2015 |
| *Amastra fraterna* Sykes, 1896 | – | – | EX? | Régnier et al., 2015 |
| *Amastra globosa* Cooke, 1933* | – | – | EX | Régnier et al., 2015 |
| *Amastra gouveii* Cooke, 1917 | – | – | EX? | Régnier et al., 2015 |
| *Amastra grayana* (Pfeiffer, 1856) | – | – | EX? | Régnier et al., 2015 |
| *Amastra gulickiana* Hyatt and Pilsbry, 1911 | – | – | EX? | Régnier et al., 2015 |
| *Amastra hawaiiensis* Hyatt and Pilsbry, 1911 | – | – | EX? | Régnier et al., 2015 |
| *Amastra hitchcocki* Cooke, 1917* | – | – | EX | Régnier et al., 2015 |
| *Amastra humilis* (Newcomb, 1855) | – | – | EX? | Régnier et al., 2015 |
| *Amastra hutchinsonii* (Pease, 1862) | – | – | EX? | Régnier et al., 2015 |
| *Amastra implicata* Cooke, 1933 | – | – | EX | Régnier et al., 2015 |
| *Amastra inflata* (Pfeiffer, 1856) | – | – | EX? | Régnier et al., 2015 |
| *Amastra inopinata* Cooke, 1933* | – | – | EX | Régnier et al., 2015 |
| *Amastra irwiniana* Cooke, 1908 | – | – | EX | Régnier et al., 2015 |
| *Amastra johnsoni* Hyatt and Pilsbry, 1911 | – | – | EX? | Régnier et al., 2015 |
| *Amastra juddii* Cooke, 1917 | – | – | EX | Régnier et al., 2015 |
| *Amastra kalamaulensis* Pilsbry and Cooke, 1914 | – | – | EX? | Régnier et al., 2015 |
| *Amastra kauaiensis* (Newcomb, 1860) | – | – | EX | Régnier et al., 2015 |
| *Amastra kaunakakaiensis* Pilsbry and Cooke, 1914 | – | – | EX | Régnier et al., 2015 |
| *Amastra knudsenii* (Baldwin, 1895) | – | – | EX | Régnier et al., 2015 |
| *Amastra laeva* Baldwin, 1906 | – | – | EX | Régnier et al., 2015 |
| *Amastra lahainana* Pilsbry and Cooke, 1914 | – | – | EX | Régnier et al., 2015 |
| *Amastra lineolata* (Newcomb, 1853) | – | – | EX? | Régnier et al., 2015 |
| *Amastra luctuosa* (Pfeiffer, 1856) | – | – | EX? | Régnier et al., 2015 |
| *Amastra luteola* (Férrusac, 1825) | – | – | EX? | Régnier et al., 2015 |
| *Amastra magna* (Adams, 1851) | – | – | EX? | Régnier et al., 2015 |

(*Continued*)

**Table A3.** (cont.)

| Species | Red List | Régnier et al., 2009 | This study | Source for revised status; comments |
|---|---|---|---|---|
| *Amastra makawaoensis* Hyatt and Pilsbry, 1911 | – | – | EX | Régnier et al., 2015 |
| *Amastra malleata* Smith, 1873 | – | – | EX? | Régnier et al., 2015 |
| *Amastra mastersi* (Newcomb, 1854) | – | – | EX? | Régnier et al., 2015 |
| *Amastra melanosis* (Newcomb, 1854) | – | – | EX | Régnier et al., 2015 |
| *Amastra metamorpha* Pilsbry and Cooke, 1914 | – | – | EX | Régnier et al., 2015 |
| *Amastra mirabilis* Cooke, 1917 | – | – | EX | Régnier et al., 2015 |
| *Amastra modesta* (Adams, 1851) | – | – | EX? | Régnier et al., 2015 |
| *Amastra modicella* Cooke, 1917 | – | – | EX? | Régnier et al., 2015 |
| *Amastra moesta* (Newcomb, 1854) | – | – | EX? | Régnier et al., 2015 |
| *Amastra montagui* Pilsbry, 1913 | – | – | EX? | Régnier et al., 2015 |
| *Amastra montana* Baldwin, 1906 | – | – | EX | Régnier et al., 2015 |
| *Amastra montivaga* Cooke, 1917 | – | – | EX? | Régnier et al., 2015 |
| *Amastra morticina* Hyatt and Pilsbry, 1911* | – | – | EX | Régnier et al., 2015 |
| *Amastra mucronata* (Newcomb, 1853) | – | – | EX? | Régnier et al., 2015 |
| *Amastra nana* (Baldwin, 1895) | – | – | EX? | Régnier et al., 2015 |
| *Amastra nannodes* Cooke, 1933 | – | – | EX | Régnier et al., 2015 |
| *Amastra neglecta* Pilsbry and Cooke, 1914 | – | – | EX? | Régnier et al., 2015 |
| *Amastra nigra* (Pfeiffer, 1856) | – | – | EX? | Régnier et al., 2015 |
| *Amastra nubifera* Hyatt and Pilsbry, 1911 | – | – | EX? | Régnier et al., 2015 |
| *Amastra nubigena* Pilsbry and Cooke, 1914 | – | – | EX? | Régnier et al., 2015 |
| *Amastra nubilosa* (Mighels, 1845) | – | – | EX? | Régnier et al., 2015 |
| *Amastra nucleola* (Gould, 1845) | – | – | EX | Régnier et al., 2015 |
| *Amastra nucula* Smith, 1873 | – | – | EX? | Régnier et al., 2015 |
| *Amastra obesa* (Newcomb, 1853) | – | – | EX? | Régnier et al., 2015 |
| *Amastra oswaldi* Cooke, 1933 | – | – | EX? | Régnier et al., 2015 |
| *Amastra ovatula* Cooke, 1933* | – | – | EX | Régnier et al., 2015 |
| *Amastra pagodula* Cooke, 1917* | – | – | EX | Régnier et al., 2015 |
| *Amastra paulula* Cooke, 1917 | – | – | EX? | Régnier et al., 2015 |
| *Amastra peasei* Smith, 1873 | – | – | EX? | Régnier et al., 2015 |
| *Amastra pellucida* (Baldwin, 1895) | EX 1994 | EX | EX | Régnier et al., 2015 |
| *Amastra perversa* Hyatt and Pilsbry, 1911* | – | – | EX | Régnier et al., 2015 |
| *Amastra petricola* (Newcomb, 1855) | – | – | EX? | Régnier et al., 2015 |
| *Amastra pilsbryi* Cooke, 1913 | – | – | EX? | Régnier et al., 2015 |
| *Amastra porcus* Hyatt and Pilsbry, 1911 | EX 1994 | EX | EX | Régnier et al., 2015 |
| *Amastra porphyrostoma* (Pease, 1869) | – | – | EX? | Régnier et al., 2015 |
| *Amastra praeopima* Cooke, 1917 | – | – | EX? | Régnier et al., 2015 |
| *Amastra problematica* Cooke, 1933 | – | – | EX? | Régnier et al., 2015 |
| *Amastra pullata* (Baldwin, 1895) | – | – | EX? | Régnier et al., 2015 |
| *Amastra pusilla* (Newcomb, 1854) | – | – | EX? | Régnier et al., 2015 |
| *Amastra reticulata* (Newcomb, 1854) | EX 1994 | EX | EX | Régnier et al., 2015 |
| *Amastra ricei* Cooke, 1917 | – | – | EX | Régnier et al., 2015 |
| *Amastra rubida* Gulick, 1873 | – | – | EX? | Régnier et al., 2015 |
| *Amastra rubristoma* Baldwin, 1906 | – | – | EX? | Régnier et al., 2015 |
| *Amastra rugulosa* Pease, 1870 | – | – | EX | Régnier et al., 2015 |
| *Amastra seminigra* Hyatt and Pilsbry, 1911 | – | – | EX | Régnier et al., 2015 |
| *Amastra seminuda* Baldwin, 1906 | – | – | EX? | Régnier et al., 2015 |
| *Amastra senilis* Baldwin, 1903* | – | – | EX | Régnier et al., 2015 |
| *Amastra sericea* (Pfeiffer, 1859 | – | – | EX? | Régnier et al., 2015 |
| *Amastra similaris* Pease, 1870 | – | – | EX | Régnier et al., 2015 |
| *Amastra sinistrorsa* Baldwin, 1906* | – | – | EX | Régnier et al., 2015 |
| *Amastra sola* Hyatt and Pilsbry, 1911 | – | – | EX? | Régnier et al., 2015 |
| *Amastra soror* (Pfeiffer, 1868) | – | – | EX | Régnier et al., 2015 |
| *Amastra spaldingi* Cooke, 1908 | – | – | EX | Régnier et al., 2015 |
| *Amastra sphaerica* Pease, 1870 | – | – | EX | Régnier et al., 2015 |
| *Amastra spicula* Cooke, 1917 | – | – | EX? | Régnier et al., 2015 |
| *Amastra subcornea* Hyatt and Pilsbry, 1911* | – | – | EX | Régnier et al., 2015 |
| *Amastra subcrassilabris* Hyatt and Pilsbry, 1911 | – | – | EX? | Régnier et al., 2015 |
| *Amastra subobscura* Hyatt and Pilsbry, 1911 | – | – | EX? | Régnier et al., 2015 |

(*Continued*)

**Table A3.** (cont.)

| Species | Red List | Régnier et al., 2009 | This study | Source for revised status; comments |
|---|---|---|---|---|
| *Amastra subrostrata* (Pfeiffer, 1859 | EX 1994 | EX | EX | Régnier et al., 2015 |
| *Amastra subsoror* Hyatt and Pilsbry, 1911 | EX 1994 | EX | EX | Régnier et al., 2015 |
| *Amastra sykesi* Hyatt and Pilsbry, 1911 | – | – | EX? | Régnier et al., 2015 |
| *Amastra tenuilabris* Gulick, 1873 | – | – | EX? | Régnier et al., 2015 |
| *Amastra tenuispira* (Baldwin, 1895) | EX 1994 | EX | EX | Régnier et al., 2015 |
| *Amastra textilis* (Férrusac, 1825) | – | – | EX? | Régnier et al., 2015 |
| *Amastra thaanumi* Hyatt and Pilsbry, 1911 | – | – | EX? | Régnier et al., 2015 |
| *Amastra thurstoni* Cooke, 1917* | – | – | EX | Régnier et al., 2015 |
| *Amastra transversalis* (Pfeiffer, 1856) | – | – | EX? | Régnier et al., 2015 |
| *Amastra tricincta* Hyatt and Pilsbry, 1911 | – | – | EX? | Régnier et al., 2015 |
| *Amastra tristis* (Férrusac, 1825) | – | – | EX? | Régnier et al., 2015 |
| *Amastra turritela* (Férrusac, 1821) | – | – | EX? | Régnier et al., 2015 |
| *Amastra ultima* Pilsbry and Cooke, 1914 | – | – | EX | Régnier et al., 2015 |
| *Amastra umbilicata* (Pfeiffer, 1856) | EX 1996 | EX | EX | Régnier et al., 2015 |
| *Amastra umbrosa* (Baldwin, 1895) | – | – | EX? | Régnier et al., 2015 |
| *Amastra undata* (Baldwin, 1895) | – | – | EX? | Régnier et al., 2015 |
| *Amastra uniplicata* (Hartman, 1888) | – | – | EX? | Régnier et al., 2015 |
| *Amastra variegata* (Pfeiffer, 1849) | – | – | EX? | Régnier et al., 2015 |
| *Amastra vetusta* (Baldwin, 1895)* | – | – | EX | Régnier et al., 2015 |
| *Amastra violacea* (Newcomb, 1853) | – | – | EX? | Régnier et al., 2015 |
| *Amastra viriosa* Cooke, 1917 | – | – | EX | Régnier et al., 2015 |
| *Amastra whitei* Cooke, 1917 | – | – | EX | Régnier et al., 2015 |
| *Armsia petasus* (Ancey, 1899) | – | – | EX? | Régnier et al., 2015 |
| *Carelia anceophila* Cooke, 1931 | EX 1990 | EX | EX | Régnier et al., 2015 |
| *Carelia bicolor* (Jay, 1839) | EX 1990 | EX | EX | Régnier et al., 2015 |
| *Carelia cochlea* (Reeve, 1849)* | EX 1990 | EX | EX | Régnier et al., 2015 |
| *Carelia cumingiana* (Pfeiffer, 1855) | EX 1990 | EX | EX | Régnier et al., 2015 |
| *Carelia dolei* Ancey, 1893* | EX 1990 | EX | EX | Régnier et al., 2015 |
| *Carelia evelynae* Cooke and Kondo, 1952* | EX 1990 | EX | EX | Régnier et al., 2015 |
| *Carelia glossema* Cooke, 1931 | EX 1990 | EX | EX | Régnier et al., 2015 |
| *Carelia hyattiana* Pilsbry, 1911 | EX 1990 | EX | EX | Régnier et al., 2015 |
| *Carelia kalalauensis* Cooke, 1931 | EX 1990 | EX | EX | Régnier et al., 2015 |
| *Carelia knudseni* Cooke, 1931 | EX 1990 | EX | EX | Régnier et al., 2015 |
| *Carelia lirata* Cooke, 1931* | EX 1990 | EX | EX | Régnier et al., 2015 |
| *Carelia lymani* Cooke, 1931* | EX 1990 | EX | EX | Régnier et al., 2015 |
| *Carelia mirabilis* Cooke, 1931* | EX 1990 | EX | EX | Régnier et al., 2015 |
| *Carelia necra* Cooke, 1931* | EX 1990 | EX | EX | Régnier et al., 2015 |
| *Carelia olivacea* Pease, 1866 | EX 1990 | EX | EX | Régnier et al., 2015 |
| *Carelia paradoxa* (Pfeiffer, 1854) | EX 1990 | EX | EX | Régnier et al., 2015 |
| *Carelia periscelis* Cooke, 1931 | EX 1990 | EX | EX | Régnier et al., 2015 |
| *Carelia pilsbryi* Sykes, 1909 | EX 1990 | EX | EX | Régnier et al., 2015 |
| *Carelia sinclairi* Ancey, 1892* | EX 1990 | EX | EX | Régnier et al., 2015 |
| *Carelia tenebrosa* Cooke, 1931 | EX 1990 | EX | EX | Régnier et al., 2015 |
| *Carelia turricula* (Mighels, 1845) | EX 1990 | EX | EX | Régnier et al., 2015 |
| *Laminella alexandri* (Newcomb, 1865) | – | – | EX | Régnier et al., 2015 |
| *Laminella bulbosa* (Gulick, 1858) | – | – | EX? | Régnier et al., 2015 |
| *Laminella citrina* (Pfeiffer, 1848) | – | – | EX? | Régnier et al., 2015 |
| *Laminella concinna* (Newcomb, 1854) | – | – | EX? | Régnier et al., 2015 |
| *Laminella depicta* (Baldwin, 1895) | – | – | EX? | Régnier et al., 2015 |
| *Laminella gravida* (Férussac, 1825) | – | – | EX? | Régnier et al., 2015 |
| *Laminella kuhnsi* (Cooke, 1908) | – | – | EX? | Régnier et al., 2015 |
| *Laminella picta* (Mighels, 1845) | – | – | EX? | Régnier et al., 2015 |
| *Laminella remyi* (Newcomb, 1855) | – | – | EX? | Régnier et al., 2015 |
| *Laminella straminea* (Reeve, 1850) | – | – | EX? | Régnier et al., 2015 |
| *Laminella tetrao* (Newcomb, 1855) | – | – | EX? | Régnier et al., 2015 |
| *Laminella venusta* (Mighels, 1845) | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina accineta* (Mighels, 1845) | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina acuminata* (Gould, 1847) | – | – | EX | Régnier et al., 2015 |

(*Continued*)

**Table A3.** (cont.)

| Species | Red List | Régnier et al., 2009 | This study | Source for revised status; comments |
|---|---|---|---|---|
| *Leptachatina anceyana* Cooke, 1910 | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina antiqua* Pease, 1870 | – | – | EX | Régnier et al., 2015 |
| *Leptachatina approximans* Ancey, 1897 | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina arborea* Sykes, 1900 | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina attenuata* Cooke, 1911 | – | – | EX | Régnier et al., 2015 |
| *Leptachatina baldwini* Cooke, 1910 | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina balteata* Pease, 1870 | – | – | EX | Régnier et al., 2015 |
| *Leptachatina brevicula* (Pease, 1869) | – | – | EX | Régnier et al., 2015 |
| *Leptachatina callosa* (Pfeiffer, 1857) | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina captiosa* Cooke, 1910 | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina cingula* (Gould, 1847) | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina compacta* (Pease, 1869) | – | – | EX | Régnier et al., 2015 |
| *Leptachatina concolor* Cooke, 1910 | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina conicoides* Sykes, 1900 | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina conspicienda* Cooke, 1910 | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina convexiuscula* Sykes, 1900 | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina cookei* Pilsbry, 1914 | – | – | EX | Régnier et al., 2015 |
| *Leptachatina corneola* (Pfeiffer, 1846) | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina coruscans* (Hartman, 1888) | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina costulata* (Gulick, 1856) | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina costulosa* Pease, 1870 | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina deceptor* Cockerell, 1927* | – | – | EX | Régnier et al., 2015 |
| *Leptachatina defuncta* Cooke, 1910* | – | – | EX | Régnier et al., 2015 |
| *Leptachatina dimidiata* (Pfeiffer, 1856) | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina dormitor* Pilsbry and Cooke, 1914* | – | – | EX | Régnier et al., 2015 |
| *Leptachatina dulcis* Cooke, 1911 | – | – | EX | Régnier et al., 2015 |
| *Leptachatina emerita* Sykes, 1900 | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina exilis* (Gulick, 1856) | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina exoptabilis* Cooke, 1910* | – | – | EX | Régnier et al., 2015 |
| *Leptachatina extensa* Pease, 1870 | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina fossilis* Cooke, 1910* | – | – | EX | Régnier et al., 2015 |
| *Leptachatina fraterna* Cooke, 1911 | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina fulgida* Cooke, 1910 | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina fumida* (Gulick, 1856) | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina fusca* (Newcomb, 1853) | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina fuscula* (Gulick, 1856) | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina gayi* Cooke, 1911 | – | – | EX | Régnier et al., 2015 |
| *Leptachatina glutinosa* (Pfeiffer, 1856) | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina grana* (Newcomb, 1853) | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina guttula* (Gould, 1847) | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina haenensis* Cockerell, 1927* | – | – | EX | Régnier et al., 2015 |
| *Leptachatina henshawi* Sykes, 1903 | – | – | EX | Régnier et al., 2015 |
| *Leptachatina hyperodon* Pilsbry and Cooke, 1914* | – | – | EX | Régnier et al., 2015 |
| *Leptachatina illimis* Cooke, 1910 | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina imitatrix* Sykes, 1900* | – | – | EX | Régnier et al., 2015 |
| *Leptachatina impressa* Sykes, 1896 | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina irregularis* (Pfeiffer, 1856) | – | – | EX | Régnier et al., 2015 |
| *Leptachatina isthmica* Ancey and Sykes, 1899* | – | – | EX | Régnier et al., 2015 |
| *Leptachatina knudseni* Cooke, 1910 | – | – | EX | Régnier et al., 2015 |
| *Leptachatina konaensis* Sykes, 1900 | – | – | EX | Régnier et al., 2015 |
| *Leptachatina kuhnsi* Cooke, 1910 | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina labiata* (Newcomb, 1853) | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina laevigata* Cooke, 1910 | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina laevis* Pease, 1870 | – | – | EX | Régnier et al., 2015 |
| *Leptachatina lagena* (Gulick, 1856) | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina lanaiensis* Cooke, 1911 | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina lanceolata* Cooke, 1911 | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina leiahiensis* Cooke, 1910* | – | – | EX | Régnier et al., 2015 |

(*Continued*)

**Table A3.** (cont.)

| Species | Red List | Régnier et al., 2009 | This study | Souree for revised status; comments |
|---|---|---|---|---|
| *Leptachatina lenta* Cooke, 1911 | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina leucochila* (Gulick, 1856) | – | – | EX | Régnier et al., 2015 |
| *Leptachatina longiuscula* Cooke, 1910 | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina lucida* Pease, 1870 | – | – | EX | Régnier et al., 2015 |
| *Leptachatina maniensis* (Pfeiffer, 1855) | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina marginata* (Gulick, 1856) | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina mcgregori* Pilsbry and Cooke, 1914 | – | – | EX | Régnier et al., 2015 |
| *Leptachatina microdon* Pilsbry and Cooke, 1914 | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina molokaiensis* Cooke, 1910 | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina morbida* Cooke, 1911 | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina nematoglypta* Pilsbry and Cooke, 1914) | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina obsoleta* (Pfeiffer, 1857) | – | – | EX | Régnier et al., 2015 |
| *Leptachatina obtusa* (Pfeiffer, 1856) | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina octogyrata* (Gulick, 1856) | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina omphalodes* (Ancey, 1899) | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina opipara* Cooke, 1910 | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina optabilis* Cooke, 1911 | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina oryza* (Pfeiffer, 1856)* | – | – | EX | Régnier et al., 2015 |
| *Leptachatina ovata* Cooke, 1910 | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina pachystoma* (Pease, 1869) | – | – | EX | Régnier et al., 2015 |
| *Leptachatina perforata* Cooke, 1911 | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina perkinsi* Sykes, 1896 | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina petila* (Gulick, 1856) | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina pilsbryi* Cooke, 1910 | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina praestabilis* Cooke, 1910 | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina pulchra* Cooke, 1910 | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina pumicata* (Mighels, 1845) | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina pupoidea* Cooke, 1911 | – | – | EX | Régnier et al., 2015 |
| *Leptachatina pyramis* (Pfeiffer, 1846) | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina resinula* (Gulick, 1856) | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina saccula* (Hartman, 1888) | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina sagittata* Pilsbry and Cooke, 1914 | – | – | EX | Régnier et al., 2015 |
| *Leptachatina sandwicensis* (Pfeiffer, 1846) | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina saxatilis* (Gulick, 1856) | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina sculpta* (Pfeiffer, 1856) | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina scutilus* (Mighels, 1845) | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina semipicta* Sykes, 1896 | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina simplex* (Pease, 1869) | – | – | EX | Régnier et al., 2015 |
| *Leptachatina smithi* Sykes, 1896 | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina somniator* Pilsbry and Cooke, 1914* | – | – | EX | Régnier et al., 2015 |
| *Leptachatina stiria* (Gulick, 1856) | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina striata* (Newcomb, 1861) | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina striatula* (Gould, 1845) | – | – | EX | Régnier et al., 2015 |
| *Leptachatina subcylindracea* Cooke, 1910* | – | – | EX | Régnier et al., 2015 |
| *Leptachatina subovata* Cooke, 1910 | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina subula* (Gulick, 1856) | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina succincta* (Newcomb, 1855) | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina supracostata* Sykes, 1900 | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina tenebrosa* Pease, 1870 | – | – | EX | Régnier et al., 2015 |
| *Leptachatina tenuicostata* (Pease, 1869)* | – | – | EX | Régnier et al., 2015 |
| *Leptachatina terebralis* (Gulick, 1856) | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina teres* (Pfeiffer, 1856) | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina thaanumi* Cooke, 1911 | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina triticea* (Gulick, 1856) | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina turrita* (Gulick, 1856) | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina vana* Sykes, 1900 | – | – | EX? | Régnier et al., 2015 |
| *Leptachatina varia* Cooke, 1910 | – | – | EX | Régnier et al., 2015 |
| *Leptachatina ventulus* (Férussac, 1825) | – | – | EX? | Régnier et al., 2015 |

*(Continued)*

**Table A3.** (cont.)

| Species | Red List | Régnier et al., 2009 | This study | Source for revised status; comments |
|---|---|---|---|---|
| *Pauahia artata* (Cooke, 1911 | – | – | EX? | Régnier et al., 2015 |
| *Pauahia chrysallis* (Pfeiffer, 1855) | – | – | EX? | Régnier et al., 2015 |
| *Pauahia tantilla* (Cooke, 1911) | – | – | EX? | Régnier et al., 2015 |
| *Planamastra digonomorpha* (Ancey, 1889) | – | – | EX? | Régnier et al., 2015 |
| *Planamastra peaseana* Pilsbry, 1911 | – | – | EX? | Régnier et al., 2015 |
| *Planamastra spaldingi* Cooke, 1933 | – | – | EX? | Régnier et al., 2015 |
| *Tropidoptera alata* (Pfeiffer, 1856) | – | – | EX | Régnier et al., 2015 |
| *Tropidoptera discus* Pilsbry and Vanatta, 1905 | – | – | EX | Régnier et al., 2015 |
| *Tropidoptera heliciformis* (Ancey, 1890) | – | – | EX? | Régnier et al., 2015 |
| *Tropidoptera rex* (Sykes, 1904) | – | – | EX? | Régnier et al., 2015 |
| *Tropidoptera wesleyi* (Sykes, 1896) | – | – | EX? | Régnier et al., 2015 |
| AMPHIBULIMULIDAE | | | | |
| *Eudolichotis euryomphala* (Jonas, 1844) | – | EX? | EX? | |
| *Eudolichotis sinuata* (Albers, 1854) | – | EX? | EX? | |
| *Plekocheilus pulicarius* (Reeve, 1848) | – | EX? | EX? | |
| *Plekocheilus succinoides* (Petit, 1840) | – | EX? | EX? | |
| ANNULARIIDAE | | | | |
| *Parachondria basicarinata* (Pfeiffer, 1855) | – | – | EX? | Watters, 2014 |
| ARIOPHANTIDAE | | | | |
| *Ariophanta thyreus* (Benson, 1852) | – | EX? | EX? | |
| *Hemiplecta neptunus* Pfeiffer, 1854 | – | EX? | EX? | |
| *Vitrinula chaunax* (Pilsbry and Hirase, 1904) | EX 1994 | – | EX | |
| *Vitrinula chichijimana* (Pilsbry and Hirase, 1905) | EX 1994 | EX | EX | |
| *Vitrinula hahajimana* (Pilsbry and Hirase, 1905) | EX 1994 | EX | EX | |
| ASSIMINEIDAE | | | | |
| *Conacmella vagans* Hirase, 1907 | – | EX | EX | |
| *Cyclomorpha secessa* Bouchet and Abdou, 2003 | – | EX | EX | |
| *Electrina succinea* (Sowerby, 1846) | – | EX | EX | |
| *Garrettia rotella* (Pease, 1868) | – | – | EX? | Brook, 2010; F. Brook, pers. comm, 2016 |
| *Kubaryia pilikia* Clench 1948 | CR(PE) 2012 | – | EX? | R.J. Rundell, pers. comm., 2016 |
| *Omphalotropis bassinblancensis* Griffiths and Florens, 2004 | – | EX | EX | |
| *Omphalotropis dupontiana* Nevill, 1878 | – | EX | EX | |
| *Omphalotropis ingens* (Mousson, 1870) | CR(PE) 2012 | – | EX? | |
| *Omphalotropis margarita* (Pfeiffer 1851) | – | EX | EX | |
| *Omphalotropis maxima* Madge, 1939 | – | EX | EX | |
| *Omphalotropis multilirata* (Pfeiffer, 1852) | – | EX | EX | |
| *Omphalotropis plicosa* (Pfeiffer, 1852) | EX 1994 | – | EX | |
| *Omphalotropis quittorensis* Griffiths and Florens, 2004 | – | EX | EX | |
| *Omphalotropis rotumana* Smith, 1897 | – | EX | EX | |
| *Omphalotropis vacoasensis* Griffiths and Florens, 2004 | – | EX | EX | |
| BOTHRIEMBRYONTIDAE | | | | |
| *Leucocharis loyaltiensis* (Souverbie, 1879) | EX 1994 | EX | EX | |
| *Leucocharis porphyrocheila* (Dautzenberg and Bernier, 1901) | EX 1994 | EX | EX | |
| *Placostylus cuniculinsulae* Cox, 1872 | EX 1996 | EX | EX | |
| *Placostylus koroensis* (Garrett, 1872) | CR(PE) 2012 | EX? | EX? | |
| BRADYBAENIDAE | | | | |
| *Calocochlia cailliaudi* Deshayes, 1839 | – | EX? | EX? | |
| *Calocochlia chlorochroa* Sowerby, 1841 | – | EX? | EX? | |
| *Calocochlia cumingii* Pfeiffer, 1842 | – | EX? | EX? | |
| *Chloraea fragilis* (Sowerby, 1841) | – | EX? | EX? | |
| *Euhadra murayamai* Habe, 1976 | DD | – | EX | Ministry of the Environment Government of Japan, 2016 |

(*Continued*)

**Table A3.** (cont.)

| Species | Red List | Régnier et al., 2009 | This study | Source for revised status; comments |
|---|---|---|---|---|
| *Euhadra nachicola* Kuroda, 1929 | DD | – | EX | Ministry of the Environment Government of Japan, 2016 |
| *Euhadra sadoensis* (Pilsbry and Hirase, 1903) | DD | – | EX | Ministry of the Environment Government of Japan, 2016 |
| *Helicostyla carbonaria* (Sowerby, 1842) | – | EX? | EX? | |
| *Helicostyla collodes* (Sowerby 1841) | – | EX | EX | |
| *Helicostyla cunctator* (Reeve, 1849) | – | EX | EX | |
| *Helicostyla daphnis* (Broderip, 1841) | – | EX | EX | |
| *Helicostyla moreleti* (Pfeiffer, 1890) | – | EX | EX | |
| *Helicostyla pfeifferi* Semper, 1877 | – | EX | EX | |
| *Helicostyla phloiodes* (Pfeiffer, 1842) | – | EX | EX | |
| *Helicostyla pilsbryi* (Hidalgo 1890) | – | EX | EX | |
| *Helicostyla propitia* (Fulton, H.C. 1907) | – | EX? | EX? | |
| *Helicostyla velata* (Broderip, 1841) | – | EX? | EX? | |
| *Helicostyla zebuensis* (Broderip, 1841) | – | EX? | EX? | |
| *Mandarina luhuana* (Sowerby, 1839) | – | EX | EX | |
| BULIMULIDAE | | | | |
| *Bulimulus achatellinus* (Forbes, 1850) | CR(PE) 2003 | – | EX? | |
| *Bulimulus adelphus* (Dall, 1917) | CR(PE) 2003 | – | EX? | |
| *Bulimulus brunoi* von Ihering, 1917 | – | EX | EX | |
| *Bulimulus deridderi* (Coppois, 1985) | CR(PE) 2003 | – | EX? | |
| *Bulimulus duncanus* (Dall, 1893) | CR(PE) 2003 | – | EX? | |
| *Bulimulus eos* (Odhner, 1951) | CR(PE) 2003 | – | EX? | |
| *Bulimulus lycodus* (Dall, 1917) | CR(PE) 2003 | – | EX? | |
| *Bulimulus saeronius* (Dall, 1917) | CR(PE) 2003 | – | EX? | |
| *Bulimulus tanneri* (Dall, 1895) | CR(PE) 2003 | – | EX? | |
| *Naesiotus arnaldoi* (Lanzieri and Rezende, 1971) | – | – | EX? | Salvador et al., 2013 |
| CAMAENIDAE | | | | |
| *Aegista inexpecta* Kuroda and Minato, 1977 | – | EX | EX | |
| *Amphidromus dohrni* (Pfeiffer, 1863) | – | EX? | EX? | |
| *Amphidromus metabletus* Moellendorff, 1900 | – | EX? | EX? | |
| *Amphidromus sinensis* (Benson, 1851) | – | EX? | EX? | |
| *Satsuma fausta* (Pilsbry, 1902) | – | – | EX | Association of Wildlife Research and EnVision Conservation Office, 2015 |
| CERASTIDAE | | | | |
| *Pachnodus curiosus* Gerlach, 2003 | EX 2009 | EX | EX | |
| *Pachnodus ladiguensis* Gerlach, 2003 | EX 2009 | EX | EX | |
| *Pachnodus velutinus* (Pfeiffer, 1868) | EX 2009 | EX | EX | |
| *Rachis comorensis* (Morelet, 1881) | EX 1994 | EX? | EX? | |
| *Rachis sanguineus* (Barclay, 1857) | EX 1994 | EX | EX | |
| *Rachistia vesiculatus* (Benson, 1859) | – | EX | EX | |
| CHAROPIDAE | | | | |
| *Charopa perryi* Smith, 1897 | – | EX | EX | |
| *Charopa rotumana* Smith 1897 | – | EX | EX | |
| *Damonita geminoropiformis* Climo, 1981 | – | – | EX | Spencer et al., 2009 |
| *Discocharopa aperta* (Moellendorff, 1888) | – | EX | EX | |
| *Helenoconcha leptalea* (Smith, 1892) | EX 1994 | EX | EX | |
| *Helenoconcha minutissima* (Smith, 1892) | EX 1994 | EX | EX | |
| *Helenoconcha polyodon* (Sowerby, 1844) | EX 1994 | EX | EX | |
| *Helenoconcha pseustes* (Smith, 1892) | EX 1994 | EX | EX | |
| *Helenoconcha sexdentata* (Smith, 1893) | EX 1994 | EX | EX | |
| *Helenodiscus bilamellata* (Sowerby, 1844) | EX 1994 | EX | EX | |
| *Helenodiscus vernoni* (Smith 1892) | EX 1994 | EX | EX | |
| *Hirasea biconcava* Hirase, 1907 | – | EX | EX | |
| *Hirasea diplomphalus* Pilsbry, 1902 | – | EX | EX | |
| *Hirasea eutheca* Hirase, 1907 | – | EX | EX | |
| *Hirasea goniobasis* Pilsbry, 1902 | – | EX | EX | |
| *Hirasea hypolia* Hirase, 1907 | – | EX | EX | |

(*Continued*)

**Table A3.** (cont.)

| Species | Red List | Régnier et al., 2009 | This study | Source for revised status; comments |
|---|---|---|---|---|
| *Hirasea insignis* Pilsbry and Hirase, 1904 | EN | – | EX | Ministry of the Environment Government of Japan, 2016 |
| *Hirasea major* Pilsbry, 1902 | – | EX | EX | |
| *Hirasea operculina* (Gould, 1859) | EN | – | EX | Ministry of the Environment Government of Japan, 2016 |
| *Hirasea sinuosa* Pilsbry, 1902 | – | EX | EX | |
| *Lauopa mbalavuana* Solem, 1983 | CR(PE) 2012 | – | EX? | |
| *Libera subcavernula* (Tryon, 1887) | EX 1994 | EX | EX | |
| *Libera tumuloides* (Garrett, 1872) | EX 1994 | EX | EX | |
| *Mautodontha acuticosta* (Garrett, 1884) | EX 1994 | EX | EX | |
| *Mautodontha consimilis* (Pease, 1868) | EX 1994 | EX | EX | |
| *Mautodontha consobrina* (Garrett, 1884) | EX 1994 | EX | EX | |
| *Mautodontha maupiensis* (Garrett, 1872) | EX 1994 | EX | EX | |
| *Mautodontha parvidens* (Pease, 1861) | EX 1994 | EX | EX | |
| *Mautodontha punctiperforata* (Garrett, 1884) | EX 1994 | EX | EX | |
| *Mautodontha saintjohni* Solem, 1976 | EX 1994 | EX | EX | |
| *Mautodontha subtilis* (Garrett, 1884) | EX 1994 | EX | EX | |
| *Mautodontha unilamellata* (Garrett, 1874) | EX 1994 | EX | EX | |
| *Mautodontha zebrina* (Garrett, 1874) | EX 1994 | EX | EX | |
| *Mocella elliottae* (Climo, 1969) | – | – | EX | Spencer et al., 2009 |
| *Mocella spelaeus* (Climo, 1971) | – | – | EX | Spencer et al., 2009 |
| *Propilula cyclaria* (Morelet, 1875) | – | EX | EX | |
| *Sinployea canalis* (Garrett, 1872) | EX 1994 | EX | EX | |
| *Sinployea decorticata* (Garrett, 1872) | EX 1994 | EX | EX | |
| *Sinployea harveyensis* (Garrett, 1872) | EX 1994 | EX | EX | |
| *Sinployea muri* Brook, 2010 | – | – | EX | Brook, 2010; F. Brook, pers. comm, 2016 |
| *Sinployea otareae* (Garrett, 1872) | EX 1994 | EX | EX | |
| *Sinployea planospira* (Garrett, 1881) | EX 1994 | EX | EX | |
| *Sinployea proxima* (Garrett, 1872) | EX 1994 | EX | EX | |
| *Sinployea rudis* (Garrett, 1872) | EX 1994 | EX | EX | |
| *Sinployea tenuicostata* (Garrett, 1872) | EX 1994 | EX | EX | |
| *Sinployea titikaveka* Brook, 2010 | – | EX? | EX | Brook, 2010; F. Brook, pers. comm, 2016 |
| *Sinployea tupapa* Brook, 2010 | – | EX? | EX | Brook, 2010; F. Brook, pers. comm, 2016 |
| *Sinployea youngi* (Garrett, 1872) | EX 1994 | EX | EX | |
| *Taipidon anceyana* (Garrett, 1887) | EX 1994 | EX | EX | |
| *Taipidon marquesana* (Garrett, 1887) | EX 1994 | EX | EX | |
| *Taipidon octolamellata* (Garrett, 1887) | EX 1994 | EX | EX | |
| *Trachycystis rariplicata* (Benson, 1887) | – | EX | EX | |
| *Zelandiscus elevatus* (Climo, 1978) | – | – | EX | Climo, 1981 |
| CHRONIDAE | | | | |
| *Trochochlamys ogasawarana* (Pilsbry, 1902) | – | EX | EX | |
| CLAUSILIDAE | | | | |
| *Neophaedusa spelaeonis* Kuroda and Minato, 1975 | DD | DD? | EX | Ministry of the Environment Government of Japan, 2016 |
| COCHLICELLIDAE | | | | |
| *Monilearia pulverulenta* (Lowe, 1861) | CR(PE) 2011 | – | EX? | |
| CYCLOPHORIDAE | | | | |
| *Cyclophorus acutimarginatus* (Sowerby, 1842) | – | EX? | EX? | |
| *Cyclophorus stenomphalus* (Pfeiffer, 1846) | – | EX? | EX? | |
| *Nobuea kurodai* Minato and Tada, 1978 | DD 1996 | – | EX | Ministry of the Environment Government of Japan, 2016 |
| DIPLOMMATINIDAE | | | | |
| *Diplommatina alata* (Crosse 1866) | CR(PE) 2012 | – | EX? | R.J. Rundell, pers. comm., 2016 |
| *Diplommatina aurea* Beddome 1889 | CR(PE) 2012 | – | EX? | R.J. Rundell, pers. comm., 2016 |

(*Continued*)

**Table A3.** (cont.)

| Species | Red List | Régnier et al., 2009 | This study | Source for revised status; comments |
|---|---|---|---|---|
| *Diplommatina gibboni* Beddome 1889 | CR(PE) 2012 | – | EX? | R.J. Rundell, pers. comm., 2016 |
| *Opisthostoma decrespignyi* (H. Adams, 1865) | CR(PE) 2004 | EX? | EX? | |
| *Opisthostoma otostoma* Boettger, 1893 | CR(PE) 2004 | EX? | EX? | |
| *Palaina albata* (Beddome 1889) | CR(PE) 2012 | – | EX? | R.J. Rundell, pers. comm., 2016 |
| *Palaina patula* (Crosse 1866) | CR(PE) 2012 | – | EX? | R.J. Rundell, pers. comm., 2016 |
| *Palaina platycheilus* (Beddome 1889) | CR(PE) 2012 | – | EX? | R.J. Rundell, pers. comm., 2016 |
| *Palaina pupa* Crosse 1866 | CR(PE) 2012 | – | EX? | R.J. Rundell, pers. comm., 2016 |
| *Plectostoma charasense* (Tomlin, 1948) | CR(PE) 2014 | – | EX? | |
| *Plectostoma dindingense* Liew et al., 2014 | CR(PE) 2014 | – | EX? | |
| *Plectostoma sciaphilum* (van Benthem Jutting, 1952) | EX 2014 | – | EX | Schilthuizen and Clements, 2008; Liew et al., 2014 |
| *Plectostoma turriforme* (van Benthem Jutting, 1952) | CR(PE) 2014 | – | EX? | |
| DISCIDAE | | | | |
| *Keraea garachicoensis* (Wollaston 1878) | – | EX | EX | |
| DYAKIIDAE | | | | |
| *Dyakia clippeus* (Mousson, 1849) | – | EX? | EX? | |
| ENDODONTIDAE | | | | |
| *Aaadonta angaurana* Solem 1976 | CR(PE) 2012 | – | EX? | R.J. Rundell, pers. comm., 2016 |
| *Aaadonta kinlochi* Solem 1976 | CR(PE) 2012 | – | EX? | R.J. Rundell, pers. comm., 2016 |
| *Aaadonta pelewana* Solem 1976 | CR(PE) 2012 | – | EX? | R.J. Rundell, pers. comm., 2016 |
| *Anceyodonta alternata* Cooke and Solem, 1976 | – | EX | EX | |
| *Anceyodonta andersoni* Cooke and Solem, 1976 | – | EX | EX | |
| *Anceyodonta constricta* Cooke and Solem, 1976 | – | EX | EX | |
| *Anceyodonta densicostata* Cooke and Solem, 1976 | – | EX | EX | |
| *Anceyodonta difficilis* Solem, 1976 | – | EX | EX | |
| *Anceyodonta ganhutuensis* Cooke and Solem, 1976 | – | EX | EX | |
| *Anceyodonta gatavakensis* Abdou and Bouchet, 2000 | – | EX | EX | |
| *Anceyodonta hamyana* (Ancey, 1889) | – | EX | EX | |
| *Anceyodonta labiosa* Solem, 1976 | – | EX | EX | |
| *Anceyodonta obesa* Solem, 1976 | – | EX | EX | |
| *Anceyodonta sexlamellata* (Pfeiffer, 1845) | – | EX | EX | |
| *Anceyodonta soror* Solem, 1976 | – | EX | EX | |
| *Anceyodonta subconica* Solem and Cooke, 1976 | – | EX | EX | |
| *Anceyodonta umbilicata* Abdou and Bouchet, 2000 | – | EX | EX | |
| *Australdonta anneae* Sartori et al., 2013 | – | – | EX | Sartori et al., 2013 |
| *Australdonta collicella* Zimmermann et al., 2009 | – | – | EX | |
| *Australdonta ectopia* Solem, 1976 | – | EX | EX | |
| *Australdonta florencei* Sartori et al., 2013 | – | – | EX | Sartori et al., 2013 |
| *Australdonta magnasulcatissima* Zimmermann et al., 2009 | – | – | EX | Zimmerman et al., 2009 |
| *Australdonta microspiralis* Zimmermann et al., 2009 | – | – | EX | Zimmermann et al., 2009 |
| *Australdonta oheatora* Sartori, Gargominy and Fontaine, 2013 | – | – | EX | Sartori et al., 2013 |
| *Australdonta pakalolo* Sartori, Gargominy and Fontaine, 2013 | – | – | EX | Sartori et al., 2013 |
| *Australdonta pharcata* Solem, 1976 | – | EX | EX | |
| *Australdonta pseudplanulata* Solem, 1976 | – | EX | EX | |
| *Australdonta rimatarana* Solem, 1976 | – | EX | EX | |
| *Australdonta sibleti* Sartori et al., 2013 | – | – | EX | Sartori et al., 2013 |
| *Australdonta sulcata* Zimmermann et al., 2009 | – | – | EX | Zimmermann et al., 2009 |
| *Australdonta teaae* Sartori et al., 2013 | – | – | EX | Sartori et al., 2013 |
| *Australdonta tubuaiana* Solem, 1976 | – | EX | EX | |
| *Endodonta apiculata* (Ancey, 1889) | CR(PE) 2000 | – | EX? | |
| *Gambiodonta agakauitaiana* Solem and Cooke, 1976 | – | EX | EX | |
| *Gambiodonta grandis* Cooke and Solem, 1976 | – | EX | EX | |
| *Gambiodonta mangarevana* Solem and Cooke, 1976 | – | EX | EX | |
| *Gambiodonta mirabilis* Cooke and Solem, 1976 | – | EX | EX | |

(*Continued*)

**Table A3.** (cont.)

| Species | Red List | Régnier et al., 2009 | This study | Source for revised status; comments |
|---|---|---|---|---|
| *Gambiodonta pilsbryi* Cooke and Solem, 1976 | – | EX | EX | |
| *Gambiodonta tumida* Cooke and Solem, 1976 | – | EX | EX | |
| *Hirasea planulata* Pilsbry and Hirase, 1903 | EX 1994 | EX | EX | |
| *Kleokyphus callimus* Solem, 1976 | – | – | EX | Sartori et al., 2014 |
| *Kleokyphus cowiei* Sartori et al., 2014 | – | – | EX | Sartori et al., 2014 |
| *Kleokyphus hypsus* Solem, 1976 | – | – | EX | Sartori et al., 2014 |
| *Mautodontha aurora* Sartori et al., 2014 | – | – | EX | Sartori et al., 2014 |
| *Mautodontha ceuthma* Solem, 1976 | – | EX | EX | |
| *Mautodontha domaneschii* Sartori et al., 2014 | – | – | EX | Sartori et al., 2014 |
| *Mautodontha harperae* Sartori et al., 2014 | – | – | EX | Sartori et al., 2014 |
| *Mautodontha makateaensis* Sartori et al., 2014 | – | – | EX | Sartori et al., 2014 |
| *Mautodontha occidentalis* Sartori et al., 2014 | – | – | EX | Sartori et al., 2014 |
| *Mautodontha passosi* Sartori et al., 2014 | – | – | EX | Sartori et al., 2014 |
| *Mautodontha rarotongensis* (Pease, 1870) | – | – | EX? | Brook et al., 2010; F. Brook, pers. comm., 2016 |
| *Mautodontha spelunca* Sartori et al., 2014 | – | – | EX | Sartori et al., 2014 |
| *Mautodontha temaoensis* Sartori et al., 2014 | – | – | EX | Sartori et al., 2014 |
| *Mautodontha virginiae* Sartori et al., 2014 | – | – | EX | Sartori et al., 2014 |
| *Minidonta anatonuana* Solem, 1976 | – | EX | EX | |
| *Minidonta aroa* Brook, 2010 | – | – | EX | Brook, 2010; F. Brook, pers. comm., 2016 |
| *Minidonta arorangi* Brook, 2010 | – | – | EX | Brook, 2010; F. Brook, pers. comm., 2016 |
| *Minidonta bieleri* Sartori et al., 2013 | – | – | EX | Sartori et al., 2013 |
| *Minidonta boucheti* Sartori et al., 2013 | – | – | EX | Sartori et al., 2013 |
| *Minidonta extraria* Cooke and Solem, 1976 | – | EX | EX | |
| *Minidonta flammulina* Abdou and Bouchet, 2000 | – | EX | EX | |
| *Minidonta gravacosta* Solem, 1976 | – | EX | EX | |
| *Minidonta haplaenopla* Solem, 1976 | – | EX | EX | |
| *Minidonta iota* Brook, 2010 | – | – | EX | Brook, 2010; F. Brook, pers. comm., 2016 |
| *Minidonta kavera* Brook, 2010 | – | – | EX | Brook, 2010; F. Brook, pers. comm., 2016 |
| *Minidonta macromphalus* Preece, 1998 | – | EX | EX | |
| *Minidonta manuaensis* Solem, 1976 | – | EX | EX | |
| *Minidonta micra* Solem and Cooke, 1976 | – | EX | EX | |
| *Minidonta micraconica* Solem, 1976 | – | EX | EX | |
| *Minidonta ngatangiia* Brook, 2010 | – | – | EX | Brook, 2010; F. Brook, pers. comm., 2016 |
| *Minidonta perminima* Abdou and Bouchet, 2000 | – | EX | EX | |
| *Minidonta planulata* Solem, 1976 | – | EX | EX | |
| *Minidonta pue* Brook, 2010 | – | – | EX | Brook, 2010; F. Brook, pers. comm., 2016 |
| *Minidonta rutaki* Brook, 2010 | – | – | EX | Brook, 2010; F. Brook, pers. comm., 2016 |
| *Minidonta simulata* Solem and Cooke, 1976 | – | EX | EX | |
| *Minidonta sulcata* Solem, 1976 | – | EX | EX | |
| *Minidonta taravensis* Solem and Cooke, 1976 | – | EX | EX | |
| *Minidonta taunensis* Solem and Cooke, 1976 | – | EX | EX | |
| *Minidonta vallonia* Abdou and Bouchet, 2000 | – | EX | EX | |
| *Pseudohelenoconcha spurca* (Sowerby, 1844) | EX 1994 | EX | EX | |
| *Pseudolibera aubertdelaruei* Sartori et al., 2014 | – | – | EX | Sartori et al., 2014 |
| *Pseudolibera cookei* Sartori et al., 2014 | – | – | EX | Sartori et al., 2014 |
| *Pseudolibera elieporoii* Sartori et al., 2014 | – | – | EX | Sartori et al., 2014 |
| *Pseudolibera extincta* Sartori et al., 2014 | – | – | EX | Sartori et al., 2014 |
| *Pseudolibera lillianae* Solem, 1976 | – | – | EX | Sartori et al., 2014 |
| *Pseudolibera matthieui* Sartori et al., 2014 | – | – | EX | Sartori et al., 2014 |
| *Pseudolibera paraminderae* Sartori et al., 2014 | – | – | EX | Sartori et al., 2014 |

(*Continued*)

**Table A3.** (cont.)

| Species | Red List | Régnier et al., 2009 | This study | Source for revised status; comments |
|---|---|---|---|---|
| *Pseudolibera parva* Sartori et al., 2014 | – | – | EX | Sartori et al., 2014 |
| *Pseudolibera solemi* Sartori et al., 2014 | – | – | EX | Sartori et al., 2014 |
| *Rikitea insolens* Cooke and Solem, 1976 | – | EX | EX | |
| *Rikitea tapinoptyx* Abdou and Bouchet, 2000 | – | EX | EX | |
| *Thaumatodon multilamellata* (Garrett, 1872) | EX 1994 | EX | EX | |
| ENIDAE | | | | |
| *Mirus hachijoensis* (Kuroda, 1945) | DD | – | EX | Ministry of the Environment Government of Japan, 2016 |
| EUCONULIDAE | | | | |
| *Advena campbelli* (Gray, 1834) | EX 1996 | EX | EX | |
| *Aukena endodonta* Bouchet and Abdou, 2001 | – | EX | EX | |
| *Aukena tridentata* (Baker, 1940) | – | EX | EX | |
| *Coneuplecta turrita* (Semper, 1873) | CE(PE) 2012 | – | EX? | |
| *Cookeana anathesis* Baker, 1938 | – | EX | EX | |
| *Cookeana vindex* Baker, 1938 | – | EX | EX | |
| *Diastole matafaoi* Baker, 1938 | EX 1996 | – | EX | |
| *Diastole rurutui* Baker, 1938 | – | EX | EX | |
| *Fanulena perrugosa* Iredale, 1945 | EX 1996 | EX | EX | |
| *Lamprocystis rurutuana* Baker, 1938 | – | EX | EX | |
| *Microcystis adusta* Baker, 1938 | – | EX | EX | |
| *Microcystis andersoni* Baker, 1938 | – | EX | EX | |
| *Microcystis kondoi* Baker, 1938 | – | EX | EX | |
| *Nancibella quintalia* (Cox, 1870) | EX 1996 | EX | EX | |
| *Philonesia pyramidalis* Preece, 1998 | – | EX | EX | |
| *Philonesia weisleri* Preece, 1998 | – | EX | EX | |
| *Quintalia flosculus* Cox, 1866 | EX 1996 | EX | EX | |
| *Quintalia stoddartii* Gray, 1834 | EX 1996 | EX | EX | |
| GASTROCOPTIDAE | | | | |
| *Campolaemus perexilis* (Smith, 1892) | EX 1994 | EX | EX | |
| *Gastrocopta chichijimana* Pilsbry, 1916 | EX 1994 | – | EX | |
| *Gastrocopta ogasawarana* Pilsbry, 1916 | EX 1994 | – | EX | |
| GASTRODONTIDAE | | | | |
| *Atlantica engonata* (Shuttleworth, 1852) | – | EX | EX | |
| *Atlantica retexta* (Shuttleworth, 1852) | – | EX | EX | |
| *Atlantica textilis* (Shuttleworth, 1852) | – | EX | EX | |
| *Janulus pompylius* (Shuttleworth, 1852) | – | EX | EX | |
| *Poecilozonites reinianus* (Pfeiffer, 1863) | – | EX | EX | |
| HELICARIONIDAE | | | | |
| *Caldwellia philyrina* Morelet, 1873 | EX 1996 | – | EX | |
| *Ctenoglypta newtoni* (Nevill, 1871) | EX 1994 | EX | EX | |
| *Ctenophila aigretteianum* Griffiths, 2000 | – | EX | EX | |
| *Dancea bewsheriana* (Morelet, 1875) | – | EX | EX | |
| *Dupontia affouchensis* Griffiths, 2000 | – | EX | EX | |
| *Dupontia proletaria* (Morelet, 1860) | EX 1996 | – | EX | |
| *Epiglypta howinsulae* (Cox, 1873) | – | EX | EX | |
| *Erepta chloritiformis* Griffiths and Vincent, 2004 | – | EX | EX | |
| *Erepta nevilli* (H. Adams, 1867) | EX 1994 | EX | EX | |
| *Erepta pyramidalis* Griffiths and Florens, 2004 | – | EX | EX | |
| *Erepta thiriouxi* (Germain, 1918) | – | EX | EX | |
| *Erepta wendystrahmi* Griffiths, 2000 | – | EX | EX | |
| *Harmogenanina linophora* (Morelet, 1860) | EX 1994 | – | EX | |
| *Harmogenanina subdetecta* Germain, 1921 | EX 1994 | – | EX | |
| *Hirasiella clara* Pilsbry, 1902 | – | EX | EX | |
| *Pachystyla rufozonata* (H. Adams), 1867 | EX 1994 | – | EX | |
| *Pachystyla waynepagei* Griffiths, 2000 | – | EX | EX | |
| *Plegma duponti* (Morelet, 1866) | – | EX | EX | |
| *Pseudophasis nevilli* (H. Adams, 1867) | – | EX | EX | |
| HELICIDAE | | | | |

(*Continued*)

**Table A3.** (cont.)

| Species | Red List | Régnier et al., 2009 | This study | Source for revised status; comments |
|---|---|---|---|---|
| *Hemicycla modesta* (Férussac, 1821) | CR(PE) 2011 | – | EX? | |
| HELICINIDAE | | | | |
| *Alcadia guadeloupensis* (Sowerby, 1842) | – | EX | EX | |
| *Nesiocina abdoui* Richling and Bouchet, 2013 | – | – | EX | Richling and Bouchet, 2013 |
| *Nesiocina gambierensis* Richling and Bouchet, 2013 | – | – | EX | Richling and Bouchet, 2013 |
| *Nesiocina grohi* Richling and Bouchet, 2013 | – | – | EX | Richling and Bouchet, 2013 |
| *Nesiocina mangarevae* Richling and Bouchet, 2013 | – | – | EX | Richling and Bouchet, 2013 |
| *Nesiocina pauciplicata* Richling and Bouchet, 2013 | – | – | EX | Richling and Bouchet, 2013 |
| *Nesiocina pazi* (Crosse 1865) | – | – | EX | Richling and Bouchet, 2013 |
| *Nesiocina superoperculata* Richling and Bouchet, 2013 | – | – | EX | Richling and Bouchet, 2013 |
| *Nesiocina trilamellata* Richling and Bouchet, 2013 | – | – | EX | Richling and Bouchet, 2013 |
| *Nesiocina unilamellata* Richling and Bouchet, 2013 | – | – | EX | Richling and Bouchet, 2013 |
| *Ogasawarana arata* Pilsbry, 1902 | DD | – | EX | Ministry of the Environment Government of Japan, 2016 |
| *Ogasawarana capsula* Pilsbry, 1902 | DD | – | EX | Ministry of the Environment Government of Japan, 2016 |
| *Ogasawarana chichijimana* Minato, 1980 | – | EX | EX | |
| *Ogasawarana discrepans* Pilsbry, 1902 | DD | – | EX | Ministry of the Environment Government of Japan, 2016 |
| *Ogasawarana habei* Minato, 1980 | – | EX | EX | |
| *Ogasawarana metamorpha* Minato, 1980 | – | EX | EX | |
| *Ogasawarana nitida* Minato, 1980 | DD | – | EX | Ministry of the Environment Government of Japan, 2016 |
| *Ogasawarana rex* Minato, 1980 | – | EX | EX | |
| *Orobophana carinacosta* Preece, 1998 | – | EX | EX | |
| *Pleuropoma hendersoni* Preece, 1998 | – | EX | EX | |
| *Pseudotrochatella undulata* (Morelet, 1878) | – | EX | EX | |
| HOLOSPIRIDAE | | | | |
| *Holospira piloceri* (Pfeiffer, 1841) | – | EX | EX | |
| *Coelostemma richardi* Thompson, 1971 | – | EX | EX | |
| HYGROMIIDAE | | | | |
| *Discula lyelliana* (Lowe, 1852) | CR(PE) 2011 | EX | EX? | |
| *Discula tetrica* (Lowe, 1852) | CR(PE) 2011 | – | EX? | |
| *Geomitra delphinuloides* (Lowe, 1860) | CR(PE) 2011 | – | EX? | |
| *Geomitra grabhami* (Wollaston, 1878) | CR(PE) 2011 | EX | EX? | |
| *Helicopsis paulhessei* (Lindholm, 1936) | EX 2011 | – | EX | |
| *Montserratina becasis* (Rambur, 1868) | CR(PE) 2011 | – | EX? | |
| *Pseudocampylaea loweii* (Férussac, 1835) | EX 1996 | EX | EX | |
| *Trochoidea picardi* (Haas, 1955) | EX 1996 | EX | EX | |
| LAURIIDAE | | | | |
| *Leiostyla abbreviata* Lowe, 1852 | CR(PE) 2011 | – | EX? | |
| *Leiostyla cassida* (Lowe, 1831) | CR(PE) 2011 | – | EX? | |
| *Leiostyla gibba* Lowe, 1852 | CR(PE) 2011 | – | EX? | |
| *Leiostyla lamellosa* Lowe, 1852 | EX 2011 | EX | EX | |
| *Leiostyla simulator* (Pilsbry, 1923) | CR(PE) 2011 | – | EX? | |
| MEGALOMASTOMATIDAE | | | | |
| *Madgeaconcha sevathiani* Griffiths and Florens, 2004 | CR(PE) 2014 | EX | EX? | |
| NEOCYCLOTIDAE | | | | |
| *Amphicyclotulus guadeloupensis* de la Torre, et al., 1942 | EX 1996 | EX | EX | |
| *Incerticyclus cinereus* (Drouët, 1859) | EX 1996 | EX | EX | |
| ODONTOSTOMIDAE | | | | |
| *Tomigerus gibberulus* (Burrow, 1815) | EX 1996 | EX | EX | |
| *Tomigerus turbinatus* (Pfeiffer, 1845) | EX 1996 | EX | EX | |
| OLEACINIDAE | | | | |
| *Oleacina guadeloupensis* (Pfeiffer, 1857) | EX 1996 | EX | EX | |

*(Continued)*

**Table A3.** (cont.)

| Species | Red List | Régnier et al., 2009 | This study | Source for revised status; comments |
|---|---|---|---|---|
| *Oleacina paivana* (Pfeiffer, 1866) | – | EX? | EX? | |
| OREOHELICIDAE | | | | |
| *Oreohelix florida* Pilsbry, 1939 | – | EX | EX | |
| PARMACELLIDAE | | | | |
| *Cryptella tamaranensis* Hutterer, 1990 | – | EX? | EX? | |
| *Parmacella gervaisii* Moquin-Tandon, 1850 | – | EX | EX | |
| PARTULIDAE | | | | |
| *Eua globosa* Pilsbry and Cooke, 1934 | CR(PE) 2012 | – | EX? | |
| *Palaopartula leucothoe* (Semper, 1865) | CR(PE) 2012 | – | EX? | |
| *Partula arguta* (Pease, 1866) | EX 1996 | EX | EX | |
| *Partula atilis* Crampton, 1956 | EX 1994 | EX | EX | |
| *Partula aurantia* Crampton, 1932 | EX 1988 | EX | EX | |
| *Partula auriculata* Broderip, 1832 | EX 1994 | EX | EX | |
| *Partula bilineata* Pease, 1866 | EX 1996 | EX | EX | |
| *Partula clarkei* Gerlach, 2016 | – | – | EX | Gerlach, 2016 |
| *Partula cootei* Gerlach, 2016 | – | – | EX | Gerlach, 2016 |
| *Partula crassilabris* Pease, 1866 | EX 1994 | EX | EX | |
| *Partula cuneata* Crampton, 1956 | EX 1994 | EX | EX | |
| *Partula cytherea* Cooke and Crampton, 1930 | EX 1996 | EX | EX? | Gerlach, 2016 |
| *Partula dentifera* Pfeiffer, 1853 | EW 1996 | EW | EX | Gerlach, 2016 |
| *Partula desolata* Bauman and Kerr, 2013* | – | – | EX | Bauman and Kerr, 2013; Gerlach, 2016 |
| *Partula diminuta* Adams, 1851 | – | – | EX | Gerlach, 2016 |
| *Partula dolichostoma* Crampton, 1956 | EX 1994 | EX | EX | |
| *Partula dolorosa* Crampton and Cooke, 1953 | EX 1996 | EX | EX | |
| *Partula eremita* Crampton and Cook, 1953 | EX 1996 | EX | EX | |
| *Partula faba* (Gmelin, 1791) | EW 1996 | EW | EX | Gerlach, 2016 |
| *Partula garrettii* Pease, 1865 | EX 2009 | EW | EW | |
| *Partula guamensis* (Pfeiffer, 1846) | CR(PE) 2012 | – | EX | Gerlach, 2016 |
| *Partula hebe* (Pfeiffer, 1846) | EW 1996 | EW | EW | |
| *Partula jackieburchi* (Kondo, 1981) | EX 1996 | EX | EX | |
| *Partula labrusca* Crampton and Cooke, 1953 | EX 2009 | EW | EW | Gerlach, 2016 |
| *Partula langfordi* Kondo, 1970 | CR 1996 | – | EX | Kerr, 2013; Bauman and Kerr, 2013; Gerlach, 2016 |
| *Partula leptochila* Crampton, 1956 | EX 1994 | EX | EX | |
| *Partula levistriata* Crampton, 1956 | EX 1994 | EX | EX | |
| *Partula lugubris* Pease, 1865 | EX 2009 | EX | EX | |
| *Partula lutea* Lesson, 1831 | EX 1994 | EX | EX | |
| *Partula magistri* Gerlach, 2016 | – | – | EX | Gerlach, 2016 |
| *Partula makatea* Gerlach, 2016* | – | – | EX | Gerlach, 2016 |
| *Partula mirabilis* Crampton, 1924 | EW 1996 | – | EW | |
| *Partula mooreana* Hartman, 1880 | EW 1996 | EW | EW | |
| *Partula navigatoria* (Pfeiffer, 1849) | EX 2009 | EX | EW | Gerlach, 2016 |
| *Partula pearcekellyi* Gerlach, 2016 | – | – | EX | Gerlach, 2016 |
| *Partula planilabrum* Pease, 1864 | EX 1996 | EX | EX | |
| *Partula producta* Pease, 1865 | EX 1994 | EX | EX | |
| *Partula protracta* Crampton, 1956 | EX 1994 | EX | EX | |
| *Partula remota* Crampton, 1956 | EX 1994 | EX | EX | |
| *Partula rosea* Broderip, 1832 | EW 2009 | – | EW | |
| *Partula rufa* Lesson, 1831 | – | – | EX? | Gerlach, 2016 |
| *Partula sagitta* Crampton and Cooke, 1953 | EX 1996 | EX | EX | |
| *Partula salifana* Crampton, 1925 | EX 1994 | EX | EX | |
| *Partula suturalis* Pfeiffer, 1855 | EW 2009 | EW | EW | |
| *Partula tohiveana* Crampton, 1924 | EW 1996 | EW | EW | |
| *Partula tristis* Crampton and Cooke, 1953 | EW 1996 | EW | EX | Gerlach, 2016 |
| *Partula turgida* (Pease, 1865) | EX 1994 | EX | EX | |
| *Partula umbilicata* Pease, 1866 | EX 1996 | EX | EX | |
| *Partula varia* Broderip, 1832 | EW 2009 | EX | EW | Gerlach, 2016 |

(*Continued*)

**Table A3.** (cont.)

| Species | Red List | Régnier et al., 2009 | This study | Source for revised status; comments |
|---|---|---|---|---|
| *Samoana cramptoni* Pilsbry and Cooke, 1934 | CR(PE) 2012 | – | EX? | |
| *Samoana minuta* (Pfeiffer, 1856) | – | – | EX? | Gerlach, 2016 |
| *Samoana pilsbryi* Gerlach, 2016 | – | – | EX? | Gerlach, 2016 |
| PLEURODONTIDAE | | | | |
| *Discolepis desidens* (Rang, 1834) | EX 1996 | EX | EX | |
| *Polydontes perplexa* (Pfeiffer, 1850) | – | EX? | EX? | |
| *Polydontes undulata* (Férussac, 1821) | – | EX? | EX? | |
| POLYGYRIDAE | | | | |
| *Vespericola ohlone* Roth, 2003 | – | – | EX? | Roth, 2003 |
| POMATIIDAE | | | | |
| *Tropidophora carinata* (Born, 1780) | – | EX | EX | |
| *Tropidophora desmazuresi* (Crosse, 1873) | EX 1994 | – | EX | |
| *Tropidophora icterica* (Sowerby, 1847) | – | EX | EX | |
| *Tropidophora lienardi* Morelet, 1876 | – | EX | EX | |
| *Tropidophora mauritiana* (H. Adams, 1867) | – | EX | EX | |
| *Tropidophora scabra* (H.Adams, 1867) | – | EX | EX | |
| *Tropidophora semilirata* (Morelet, 1881) | EX 1994 | – | EX | Evaluated as *Tropidophora 'semilineata'* by IUCN (2016) |
| *Tropidophora vincentflorensi* Griffiths, 2000 | – | EX | EX | |
| PRISTILOMATIDAE | | | | |
| *Gyralina hausdorfi* Riedel, 1990 | – | EX | EX | |
| PUNCTIDAE | | | | |
| *Punctum mokotoense* Abdou and Bouchet, 2000 | – | EX | EX? | Abdou and Bouchet, 2000 |
| PUPILLIDAE | | | | |
| *Pupilla obliquicosta* Smith, 1892 | EX 1994 | EX | EX | |
| RHYTIDIDAE | | | | |
| *Delos gardineri* Smith, 1897 | CR(PE) 2012 | EX | EX? | Barker, 2012 |
| *Schizoglossa major* Powell, 1938 | – | – | EX | Spencer et al., 2009 |
| STREPTAXIDAE | | | | |
| *Conturbatia crenata* Gerlach, 2001 | CR(PE) 2009 | – | EX? | |
| *Gibbus lyonetianus* Pallas, 1780 | EX 1994 | EX | EX | |
| *Gonidomus newtoni* (Adams, 1867) | EX 1994 | EX | EX | |
| *Gonospira adamsiana* Nevill, 1871 | – | EX | EX | |
| *Gonospira cirueensis* Madge, 1946 | – | EX | EX | |
| *Gonospira helodes* (Morelet, 1875) | – | EX | EX | |
| *Gonospira majuscula* (Morelet, 1878) | – | EX | EX | |
| *Gonospira mondraini* (H. Adams, 1868) | – | EX | EX | |
| *Gonospira nevilli* Adams, 1867 | EX 1994 | – | EX | |
| *Gulella mamellensis* Griffiths, 2000 | – | EX | EX | |
| *Microstrophia abnornala* Griffiths, 2004 | – | EX | EX | |
| *Microstrophia baideri* Griffiths, 2004 | – | EX | EX | |
| *Plicadomus newtoni* (H. Adams, 1867) | – | EX | EX | |
| STROPHOCHEILIDAE | | | | |
| *Anthinus multicolor* Rang, 1831 | – | EX? | EX? | |
| *Anthinus turnix* (Gould 1846) | – | EX? | EX? | |
| *Gonyostomus egregius* (Pfeiffer, 1845) | – | EX? | EX? | |
| *Gonyostomus goniostoma* (Wood, 1828) | – | EX? | EX? | |
| *Megalobulimus cardosoi* (Morretes, 1952) | EX 1996 | EX | EX | |
| SUBULINIDAE | | | | |
| *Chilonopsis blofeldi* Forbes, 1852 | EX 1994 | EX | EX | |
| *Chilonopsis exulatus* (Benson, 1850) | EX 1994 | EX | EX | |
| *Chilonopsis helena* Quoy and Gaimard, 1833 | EX 1994 | EX | EX | |
| *Chilonopsis melanoides* (Wollaston, 1892) | EX 1996 | EX | EX | |
| *Chilonopsis nonpareil** (Perry, 1811) | EX 1994 | EX | EX | |
| *Chilonopsis subplicatus* (Sowerby, 1852) | EX 1994 | EX | EX | |
| *Chilonopsis subtruncatus* (Smith, 1892) | EX 1994 | EX | EX | |
| *Chilonopsis turtoni* (Smith, 1892) | EX 1994 | EX | EX | |
| *Vegrandinia trindadensis* (Breure and Coelho, 1976) | – | – | EX? | |

*(Continued)*

**Table A3.** (cont.)

| Species | Red List | Régnier et al., 2009 | This study | Source for revised status; comments |
|---|---|---|---|---|
| SUCCINEIDAE | | | | |
| *Succinea atollica* Hertlein and Allison, 1968 | – | EX | EX | |
| *Succinea rotumana* Smith, 1897 | CR(PE) 2012 | EX | EX? | Barker, 2012 |
| UROCOPTIDAE | | | | |
| *Anoma adamsi* Pilsbry, 1904 | – | EX? | EX? | |
| *Anoma alboanfractus* (Chitty, 1853) | – | EX? | EX? | |
| *Anoma dohriana* (Pfeiffer, 1871) | – | EX? | EX? | |
| *Anoma flexuosa* (Pfeiffer, 1866) | – | EX? | EX? | |
| *Anoma fuscolabris* (Chitty, 1853) | – | EX? | EX? | |
| *Anoma gossei* (Pfeiffer, 1846) | – | EX? | EX? | |
| *Anoma gracilis* (C. B. Adams, 1851) | – | EX? | EX? | |
| *Anoma integra* (C.B. Adams, 1851) | – | EX? | EX? | |
| *Anoma jarvisi* Pilsbry, 1903 | – | EX? | EX? | |
| *Anoma nitens* (Chitty, 1853) | – | EX? | EX? | |
| *Anoma prunicolor* (Chitty, 1853) | – | EX? | EX? | |
| *Anoma pulchella* (Chitty, 1853) | – | EX? | EX? | |
| *Anoma pulla* (Chitty, 1853) | – | EX? | EX? | |
| *Anoma radiata* (Chitty, 1853) | – | EX? | EX? | |
| *Anoma solida* (C. B. Adams, 1851) | – | EX? | EX? | |
| *Anoma tricolor* (Pfeiffer, 1847) | – | EX? | EX? | |
| UROCYCLIDAE | | | | |
| *Colparion madgei* Laidlaw, 1938 | EX 1994 | EX | EX | |
| *Malagarion borbonica* (Morelet, 1860) | – | EX? | EX? | |
| *Zingis radiolata* Martens, 1878 | CR(PE) 2004 | – | EX? | |
| VERTIGINIDAE | | | | |
| *Lyropupa perlonga* (Pease, 1871) | EX 1994 | EX | EX | |
| *Nesopupa turtoni* (Smith, 1892) | EX 1994 | EX | EX | |
| *Vertigo bermudensis* Pilsbry, 1919 | – | EX? | EX? | |
| *Vertigo marki* Gulick, 1904 | – | EX? | EX? | |
| ZONITIDAE | | | | |
| *Zonites embolium* Fuchs and Käufel, 1936 | – | EX | EX | |
| *Zonites santoriniensis* Riedel and Norris 1987 | – | EX | EX | Kornilios et al., 2009 |
| *Zonites siphnicus* Fuchs and Käufel 1936 | – | EX | EX | Kornilios et al., 2009 |

**Table A4.** Freshwater species considered extinct (EX), possibly extinct (EX?) or extinct in the wild (EW) in the present study, compared with their status as evaluated by Régnier et al. (2009), and on the *Red List* (IUCN, 2016). *Red List* categories are extinct (EX), extinct in the wild (EW), critically endangered (possibly extinct) (CR(PE)), critically endangered (CR), least concern (LC), and data deficient (DD); the date of the IUCN evaluation follows the status. EX? is treated as equivalent to CR(PE). A dash indicates the species was not evaluated. Sources are only provided if the status in this study differs from the later of IUCN (2016) and Régner et al. (2009).

| Species | *Red List* | Régnier et al., 2009 | This study | Source for revised status; comments |
|---|---|---|---|---|
| **GASTROPODA** | | | | |
| AMNICOLIDAE | | | | |
| *Amnicola rhombostoma* Thompson, 1968 | – | EX? | EX? | |
| *Lyogyrus bakerianus* (Pilsbry, 1917) | – | – | EX? | Johnson et al., 2013 |
| ASSIMINEIDAE | | | | |
| *Pseudogibbula cara* Pilsbry and Bequaert, 1927 | CR(PE) 2010 | – | EX? | |
| *Valvatorbis mauritii* Bequaert and Clench, 1936 | CR(PE) 2010 | – | EX? | |
| BITHYNIIDAE | | | | |
| *Gabbiella barthi* (Brown, 1980) | CR(PE) 2016 | – | EX? | |
| *Gabbiella matadina* Mandahl-Barth, 1968 | CR(PE) 2010 | – | EX? | |
| *Soapitia dageti* Binder, 1961 | CR(PE) 2010 | – | EX? | |
| BYTHINELLIDAE | | | | |
| *Bythinella eutrepha* (Paladilhe, 1867) | CR(PE) 2010 | – | EX? | |
| *Bythinella gibbosa* (Moquin-Tandon, 1856) | EX 2010 | – | EX | |
| *Bythinella limnopsis* Letourneux and Bourguignat, 1887 | EX 2010 | – | EX | |
| *Bythinella mauritanica* Letourneux and Bourguignat, 1887 | EX 2010 | – | EX | |
| *Bythinella microcochlia* Letourneux and Bourguignat, 1887 | EX 2010 | – | EX | |
| *Bythinella punica* Letourneux and Bourguignat, 1887 | EX 2010 | – | EX | |
| COCHLIOPIDAE | | | | |
| *Dyris amazonicus* (Haas, 1949) | – | EX? | EX? | |
| *Heleobia peiranoi* (Weyrauch, 1963) | – | – | EX | Rumi et al., 2006 |
| *Heleobia spinellii* (Gredler, 1859) | EX 2010 | – | EX | |
| *Heleobia steindachneri* (Westerlund, 1902) | – | EX | EX | |
| *Heleobia sublineata* (Pilsbry 1911) | – | – | EX | Rumi et al., 2006 |
| *Juturnia brunei* (Taylor, 1987) | CR(PE) 2012 | – | EX | Hershler et al., 2014 |
| *Littoridina gaudichaudii* Souleyet, 1852 | EX 1996 | EX? | EX? | |
| *Sioliella effusa* Haas, 1949 | – | EX? | EX? | |
| *Tryonia hertleini* (Drake, 1956) | – | EX | EX | |
| *Tryonia santarosae* Hershler et al., 2014 | – | – | EX | Hershler et al., 2014 |
| *Tryonia shikueii* Hershler et al., 2014 | – | – | EX | Hershler et al., 2014 |
| GLACIDORBIDAE | | | | |
| *Glacidorbis costatus* Ponder and Avern, 2000 | – | EX | EX | |
| HYDROBIIDAE | | | | |
| *Alzoniella galaica* (Boeters and Rolan, 1988) | CR(PE) 2011 | – | EX? | |
| *Antibaria notata* (Frauenfeld, 1865) | – | EX | EX | |
| *Belgrandia moitessieri* (Bourguignat, 1866) | CR(PE) 2010 | – | EX? | |
| *Belgrandia varica* (Paget, 1854) | CR(PE) 2010 | EX | EX? | Prié, 2010 |
| *Belgrandiella boetersi* Reischütz and Falkner, 1998 | CR(PE) 2010 | – | EX? | |
| *Belgrandiella cavernica* Boettger, 1957 | CR(PE) 2014 | – | EX? | |
| *Belgrandiella intermedia* (Boeters, 1970) | EX 1996 | EX | EX | |
| *Belgrandiella kreisslorum* Reischütz, 1997 | CR(PE) 2010 | – | EX? | |
| *Belgrandiella multiformis* Fischer and Reischütz, 1995 | CR(PE) 2010 | – | EX? | |
| *Bracenica spiridoni* Radoman, 1973 | – | EX | EX | |
| *Bythiospeum pfeifferi* (Clessin, 1890) | – | EX? | EX? | |
| *Dalmatinella fluviatilis* Radoman, 1973 | EN 2011 | EX | EX | Evaluated as *Vinodolia fluviatilis* by IUCN (2016) |

(*Continued*)

**Table A4.** (cont.)

| Species | *Red List* | Régnier et al., 2009 | This study | Source for revised status; comments |
|---|---|---|---|---|
| *Dianella schlickumi* Schütt, 1962 | CR(PE) 2011 | EX | EX? | |
| *Falsipyrgula beysehirana* (Schütt, 1965) | CR(PE) 2014 | – | EX? | |
| *Graecoanatolica brevis* Radoman, 1973 | CR(PE) 2014 | – | EX? | Kebapçi et al., 2012 |
| *Graecoanatolica conica* Radoman, 1973 | CR(PE) 2014 | – | EX? | Kebapçi et al., 2012 |
| *Graecoanatolica macedonica* Radoman and Stanovic, 1978 | EX 2002 | EX | EX | |
| *Hydrobia anatolica* Schütt, 1965 | CR(PE) 2014 | – | EX? | |
| *Hydrobia gracilis* Morelet, 1880 | EX 2010 | – | EX | |
| *Islamia ateni* (Boeters, 1969) | EX 2011 | – | EX | |
| *Islamia bendidis* Reischütz, 1988 | CR(PE) 2011 | – | EX? | |
| *Islamia epirana* (Schütt, 1962) | – | EX | EX | |
| *Islamia graeca* Radoman, 1973 | CR(PE) 2011 | EX | EX | |
| *Islamia hadei* (Gittenberger, 1982) | CR(PE) 2011 | EX | EX | |
| *Islamia pseudorientalica* Radoman, 1973 | CR(PE) 2014 | – | EX? | |
| *Kirelia carinata* Radoman, 1973 | CR(PE) 2014 | – | EX | |
| *Marstonia olivacea* Pilsbry, 1895 | EX 2000 | EX | EX | |
| *Mercuria punica* (Letourneux and Bourguignat, 1887) | CR(PE) 2010 | – | EX? | |
| *Nanivitrea alcaldei* (Jaume and Abbott, 1947) | – | – | EX? | Vázquez Perera and Perera Valderrama, 2010 |
| *Nanivitrea helicoides* (Gundlach, 1865) | – | – | EX? | Vázquez Perera and Perera Valderrama, 2010 |
| *Neohoratia coronadoi* (Bourguignat, 1870) | – | – | EX? | Arconada and Ramos, 2006 |
| *Ohridohauffenia drimica* (Radoman, 1964) | EX 1994 | EX | EX | |
| *Ohridohauffenia minuta* (Radoman, 1955) | CR(PE) 2010 | – | EX? | |
| *Potamopyrgus acus* Haase, 2008 | CR(PE) 2013 | – | EX? | |
| *Pseudamnicola barratei* Letourneux and Bourguignat, 1887 | EX 2010 | – | EX | |
| *Pseudamnicola doumeti* Letourneux and Bourguignat, 1887 | EX 2010 | – | EX | |
| *Pseudamnicola latasteana* Letourneux and Bourguignat, 1887 | EX 2010 | – | EX | |
| *Pseudamnicola letourneuxiana* (Bourguignat, 1862) | EX 2010 | – | EX | |
| *Pseudamnicola macrostoma* (Küster, 1853) | – | EX | EX | |
| *Pseudamnicola oudrefica* (Letourneux and Bourguignat, 1887) | EX 2010 | – | EX | |
| *Pseudamnicola ragia* Letourneux and Bourguignat, 1887 | EX 2010 | – | EX | |
| *Pseudamnicola singularis* Letourneux and Bourguignat, 1887 | EX 2010 | – | EX | |
| *Pseudoislamia balcanica* Radoman, 1979 | CR 2011 | EX | EX | |
| *Pyrgulopsis brandi* (Drake, 1953) | – | EX | EX | |
| *Pyrgulopsis carinata* Hershler, 1998 | – | EX | EX | |
| *Pyrgulopsis coloradensis* Hershler, 1998 | – | – | EX? | Center for Biological Diversity et al., 2009 |
| *Pyrgulopsis nevadensis* (Stearns, 1833) | EX 2000 | EX | EX | |
| *Pyrgulopsis ruinosa* Hershler, 1998 | – | EX | EX | |
| *Pyrgulopsis torrida* Hershler et al., 2016 | – | – | EX? | Hershler et al., 2016 |
| *Radomaniola curta* (Küster, 1853) | LC 2010 | EX | EX | |
| *Sardohoratia sulcata* Manganelli et al., 1998 | CR(PE) 2010 | – | EX? | |
| *Tanousia zrmanjae* (Brusina, 1866) | CR(PE) 2011 | EX | EX? | |
| *Trichonia kephalovrissonia* Radoman, 1973 | DD 2011 | EX | EX | Evaluated as *Heleobia steindachneri* by IUCN (2016) |

(*Continued*)

**Table A4.** (cont.)

| Species | *Red List* | Régnier et al., 2009 | This study | Source for revised status; comments |
|---|---|---|---|---|
| *Trichonia trichonica* Radoman, 1973 | CR 2011 | EX | EX | |
| *Turcorientalia hohenackeri* (Küster, 1853) | VU 2011 | EX | EX | |
| *Vinodolia fiumana* Radoman, 1973 | EN 2014 | EX | EX | |
| *Vinodolia gluhodolica* (Radoman, 1973) | EN 2010 | EX | EX | |
| *Vinodolia lacustris* (Radoman, 1973) | CR 2010 | – | EX | Albrecht et al., 2012 |
| *Vinodolia matjasici* (Bole, 1961) | CR 2010 | EX | EX | |
| *Zaumia sanctizaumi*(Radoman, 1964) | CR(PE) 2010 | – | EX? | |
| IRIDINIDAE | | | | |
| *Aspatharia divaricata* (Martens, 1897) | CR(PE) 2016 | – | EX? | |
| *Chambardia letourneuxi* | EX 2010 | – | EX | |
| LITHOGLYPHIDAE | | | | |
| *Clappia umbilicata* (Walker, 1904) | EX 2000 | EX | EX | |
| *Fluminicola minutissimus* Pilsbry, 1907 | – | – | EX ? | Johnson et al., 2013 |
| *Fluminicola nuttallianus* Lea, 1838 | – | EX | EX ? | Johnson et al., 2013 |
| *Somatogyrus crassilabris* Walker, 1915 | EX 2000 | EX | EX? | Johnson et al., 2013 |
| *Somatogyrus wheeleri* Walker, 1915 | EX 2000 | EX | EX? | Johnson et al., 2013 |
| LYMNAEIDAE | | | | |
| *Erinna aulacospira* (Ancey, 1899) | DD | – | EX? | Johsnon et al., 2013 |
| *Galba cyclostoma* (Walker, 1908) | – | – | EX? | Johnson et al., 2013 |
| *Galba perpolita* (Dall, 1905) | – | – | EX? | Johnson et al., 2013 |
| *Galba tazewelliana* (Wolf, 1870) | – | – | EX? | Johnson et al., 2013 |
| *Galba vancouverensis* (F.C. Baker, 1939) | – | – | EX? | Johnson et al., 2013 |
| *Lantzia carinata* (Jousseaume, 1872) | CR(PE) 2016 | – | EX? | |
| *Lymnaea plicata* Hylton Scott 1953 | – | – | EX | Rumi et al., 2006 |
| *Stagnicola neopalustris* (F.C. Baker, 1911) | – | – | EX? | Johnson et al., 2013 |
| *Stagnicola petoskeyensis* (Walker, 1908) | – | – | EX? | Johnson et al., 2013 |
| *Stagnicola pilsbryi* Hemphill, 1890 | EX 2012 | EX | EX | |
| *Stagnicola utahensis* (Call, 1884) | CR(PE) 2012 | – | EX | Center for Biological Diversity et al., 2009 |
| MELANOPSIDAE | | | | |
| *Melanopsis germaini* Pallary, 1939 | CR(PE) 2014 | – | EX? | |
| *Melanopsis infracincta* Martens, 1874 | CR(PE) 2014 | – | EX? | |
| *Melanopsis khabourensis* Pallary, 1939 | CR(PE) 2014 | – | EX? | |
| *Melanopsis pachya* Pallary, 1939 | CR(PE) 2014 | – | EX? | |
| *Melanopsis parreyssii* (Philippi, 1847) | CR 2011 | – | EX | Sîrbu and Benedek, 2016 |
| MOITESSIERIIDAE | | | | |
| *Henrigirardia wienini* (Girardi, 2001) | CR(PE) 2010 | – | EX? | |
| *Iglica gratulabunda* (Wagner, 1910) | CR(PE) 2010 | – | EX? | |
| *Paladilhiopsis janinensis* Schütt, 1962 | CR(PE) 2011 | EX | EX? | |
| *Spiralix corsica* Bernasconi, 1994 | CR(PE) 2010 | – | EX? | |
| NERITIDAE | | | | |
| *Neritina tiassalensis* Binder, 1955 | CR(PE) 2010 | – | EX? | |
| PACHYCHILIDAE | | | | |
| *Sulcospira martini* (Schepmann, 1898) | – | EX? | EX? | |
| *Sulcospira pisum* (Brot, 1868) | – | – | EX? | Marwoto and Isnaningsih, 2012 |
| *Sulcospira sulcospira* (Mousson, 1849) | DD 2011 | EX? | EX? | Marwoto and Isnaningsih, 2012 |
| PHYSIDAE | | | | |
| *Physella microstriata* (Chamberlain and Berry, 1930) | EX 2000 | EX | EX | |
| PLANORBIDAE | | | | |
| *Amphigyra alabamensis* Pilsbry, 1906 | EX 2000 | EX | EX | |
| *Ceratophallus concavus* (Mandahl-Barth, 1954) | CR(PE) 2016 | – | EX ? | |
| *Glyptophysa oconnori* (Cumber, 1941) | DD 2011 | – | EX | Spencer et al., 2009 |
| *Neoplanorbis carinatus* Walker, 1908 | EX 2000 | EX | EX | |
| *Neoplanorbis smithi* Walker, 1908 | EX 2000 | EX | EX | |
| *Neoplanorbis tantillus* Pilsbry, 1906 | EX 2012 | EX | EX | |
| *Neoplanorbis umbilicatus* Walker, 1908 | EX 2000 | EX | EX | |

*(Continued)*

**Table A4.** (cont.)

| Species | *Red List* | Régnier et al., 2009 | This study | Source for revised status; comments |
|---|---|---|---|---|
| *Planorbella columbiensis* (F.C. Baker, 1935) | – | – | EX? | Johnson et al., 2013 |
| *Planorbella multivolvis* (Case, 1847) | EX 2000 | EX | EX | |
| *Planorbella traskii* (Lea, 1856) | – | – | EX | Johnson et al., 2013 |
| *Rhodacmea hinkleyi* (Walker, 1908) | – | – | EX? | Johnson et al., 2013 |
| *Vorticifex solida* (Dall, 1870) | – | – | EX? | Johnson et al., 2013 |
| PLEUROCERIDAE | | | | |
| *Athearnia crassa* (Haldeman, 1841) | EX 1996 | EX | EX | |
| *Elimia brevis* (Reeve, 1860) | EX 2000 | EX | EX | |
| *Elimia clausa* (Lea, 1861) | EX 2000 | EX | EX | |
| *Elimia fusiformis* (Lea, 1861) | EX 2000 | EX | EX | |
| *Elimia gibbera* (Goodrich, 1922) | EX 2000 | EX | EX | |
| *Elimia hartmaniana* (Lea, 1861) | EX 1994 | EX | EX | |
| *Elimia impressa* (Lea, 1841) | EX 1994 | EX | EX | |
| *Elimia jonesi* (Goodrich, 1936) | EX 1994 | EX | EX | |
| *Elimia laeta* (Jay, 1839) | EX 1994 | EX | EX | |
| *Elimia macglameriana* (Goodrich, 1936) | EX 2000 | EX | EX | |
| *Elimia pilsbryi* (Goodrich, 1927) | EX 1994 | EX | EX | |
| *Elimia pupaeformis* (Lea, 1864) | EX 1994 | EX | EX | |
| *Elimia pupoidea* (Anthony, 1854) | – | – | EX | Johnson et al., 2013 |
| *Elimia pygmaea* (Smith, 1936) | EX 1994 | EX | EX | |
| *Gyrotoma excisa* (Lea, 1843) | EX 2000 | EX | EX | |
| *Gyrotoma lewisii* (Lea, 1869) | EX 2000 | EX | EX | |
| *Gyrotoma pagoda* (Lea, 1845) | EX 2000 | EX | EX | |
| *Gyrotoma pumila* (Lea, 1860) | EX 2000 | EX | EX | |
| *Gyrotoma pyramidata* (Shuttleworth, 1845) | EX 2000 | EX | EX | |
| *Gyrotoma walkeri* (Smith, 1924) | EX 2000 | EX | EX | |
| *Leptoxis clipeata* (Smith, 1922) | EX 2000 | – | EX | |
| *Leptoxis formosa* (Lea, 1860) | EX 2000 | EX | EX | |
| *Leptoxis ligata* (Anthony, 1860) | EX 2000 | EX | EX | |
| *Leptoxis lirata* (Smith, 1922) | EX 2000 | EX | EX | |
| *Leptoxis minor* (Hinkley, 1912) | – | – | EX | Johnson et al., 2013 |
| *Leptoxis occultata* (Smith, 1922) | EX 2000 | EX | EX | |
| *Leptoxis showalterii* (Lea, 1860) | EX 2000 | EX | EX | |
| *Leptoxis torrefacta* (Goodrich, 1922) | EX 2000 | EX | EX | |
| *Leptoxis trilineata* (Say, 1829) | – | – | EX | Johnson et al., 2013 |
| *Leptoxis vittata* (Lea, 1860) | EX 2000 | EX | EX | |
| *Lithasia hubrechti* Clench, 1956 | – | – | EX | Johnson et al., 2013 |
| *Lithasia jayana* (Lea, 1841) | – | – | EX | Johnson et al., 2013 |
| POMATIOPSIDAE | | | | |
| *Pomatiopsis hinkleyi* Pilsbry, 1896 | – | – | EX? | Johnson et al., 2013 |
| TATEIDAE | | | | |
| *Beddomeia tumida* Petterd, 1889 | CR(PE) 2011 | EX | EX? | Clark, 2011 |
| *Fluvidona dulvertonensis* (Tennison-Woods, 1876). | EX 1996 | EX | EX | |
| *Leiorhagium solemi* Haase and Bouchet, 1998 | EX 2011 | EX? | EX? | |
| *Posticobia norfolkensis* (Sykes, 1900) | EX 1996 | EX | EX | |
| *Potamolithus concordianus* Parodiz, 1966 | – | – | EX | Rumi et al., 2006 |
| THIARIDAE | | | | |
| *Aylacostoma brunneum* Vogler and Peso, 2014 | – | – | EW | M.G. Quintana, pers. comm., 2016 |
| *Aylacostoma chloroticum* Hylton-Scott, 1953 | EW 2000 | EW | EW | M.G. Quintana pers. comm., 2016 |
| *Aylacostoma guaraniticum* Hylton-Scott, 1953 | EW 2000 | EW | EX | Rumi et al., 2006; M.G. Quintana pers. comm., 2016 |
| *Aylacostoma stigmaticum* Hylton-Scott, 1953 | EW 2000 | EW | EX | Rumi et al., 2006; M.G. Quintana pers. comm., 2016 |

(*Continued*)

**Table A4.** (cont.)

| Species | *Red List* | Régnier et al., 2009 | This study | Source for revised status; comments |
|---|---|---|---|---|
| *Melanoides agglutinans* (Bequaert and Clench, 1941) | CR(PE) 2010 | – | EX? | |
| VALVATIDAE | | | | |
| *Valvata klemmi* Schütt, 1962 | EN 2011 | EX | EX | |
| *Valvata virens* Tryon, 1863 | – | – | EX? | Johnson et al., 2013 |
| VIVIPARIDAE | | | | |
| *Bellamya phthinotropis* (Martens, 1892) | CR(PE) 2016 | – | EX? | |
| *Viviparus bermondianus* (d'Orbigny, 1842) | – | EX | EX | |
| **BIVALVIA** | | | | |
| CORBICULIDAE | | | | |
| *Corbicula linduensis* Bollinger, 1914 | – | EX? | EX? | |
| *Corbicula subplanata* Martens, 1897 | – | EX? | EX? | |
| DREISSENIDAE | | | | |
| *Dreissena caspia* Eichwald, 1855 | CR(PE) 2011 | – | EX? | |
| MYCETOPODIDAE | | | | |
| *Anodontites moricandi* (Lea, 1860) | – | EX? | EX? | |
| SPHAERIIDAE | | | | |
| *Eupera crassa* (Mandahl-Barth, 1954) | CR(PE) 2016 | – | EX? | |
| *Pisidium betafoense* Kuiper, 1953 | CR(PE) 2016 | – | EX? | |
| UNIONIDAE | | | | |
| *Alasmidonta mccordi* Athearn, 1964 | EX 2000 | EX | EX | |
| *Alasmidonta robusta* Clarke, 1981 | EX 2000 | EX | EX | |
| *Alasmidonta wrightiana* (Walker, 1901) | EX 2000 | EX | EX | |
| *Coelatura rothschildi* (Neuville and Anthony, 1906) | CR(PE) 2016 | – | EX? | |
| *Cuneopsis demangei* Haas, 1929 | CR(PE) 2011 | – | EX? | |
| *Elliptio nigella* (Lea, 1852) | CR 2012 | EX | EX | |
| *Epioblasma arcaeformis* (Lea, 1831) | EX 2000 | EX | EX | |
| *Epioblasma biemarginata* (Lea, 1857) | EX 2000 | EX | EX | |
| *Epioblasma flexuosa* (Rafinesque, 1820) | EX 2000 | EX | EX | |
| *Epioblasma haysiana* (Lea, 1834) | EX 2000 | EX | EX | |
| *Epioblasma lenior* (Lea, 1842) | EX 2000 | EX | EX | |
| *Epioblasma lewisii* (Walker, 1910) | EX 2000 | EX | EX | |
| *Epioblasma othcaloogensis* (Lea, 1857) | CR(PE) 2012 | – | EX? | |
| *Epioblasma personata* (Say, 1829) | EX 2000 | EX | EX | |
| *Epioblasma propinqua* (Lea, 1857) | EX 2000 | EX | EX | |
| *Epioblasma sampsonii* (Lea, 1862) | EX 2000 | EX | EX | |
| *Epioblasma stewardsonii* (Lea, 1852) | EX 2000 | EX | EX | |
| *Epioblasma turgidula* (Lea, 1858) | EX 2000 | EX | EX | |
| *Germainaia geayi* (Germain, 1911) | EX 2016 | – | EX | |
| *Lamprotula crassa* (Wood, 1815) | CR(PE) 2011 | – | EX? | |
| *Lamprotula liedtkei* Rolle, 1904 | CR(PE) 2011 | – | EX? | |
| *Lamprotula nodulosa* (Wood, 1815) | CR(PE) 2011 | – | EX? | |
| *Lampsilis binominata* Simpson, 1900 | EX 2000 | EX | EX | |
| *Medionidus mcglameriae* van der Schalie, 1939 | EX 2000 | EX | EX | |
| *Obovaria haddletoni* (Athearn, 1964) | CR(PE) 2012 | – | EX? | |
| *Pleurobema altum* (Conrad, 1854) | EX 2000 | EX | EX | |
| *Pleurobema avellanum* Simpson, 1900 | EX 2000 | EX | EX | |
| *Pleurobema bournianum* (Lea, 1840) | EX 2000 | EX | EX | |
| *Pleurobema chattanoogaense* (Lea, 1858) | – | EX | EX | |
| *Pleurobema curtum* Lea, 1859 | CR(PE) 2012 | – | EX? | |
| *Pleurobema flavidulum* (Lea, 1861) | EX 2000 | – | EX | |
| *Pleurobema hagleri* Frierson, 1900 | EX 2000 | – | EX | |
| *Pleurobema hanleyianum* (Lea, 1852) | CR 2012 | EX | EX | |
| *Pleurobema johannis* (Lea, 1859) | EX 2000 | – | EX | |
| *Pleurobema murrayense* (Lea, 1868) | EX 2000 | – | EX | |
| *Pleurobema nucleopsis* (Conrad, 1849) | EX 2000 | – | EX | |

(*Continued*)

**Table A4.** (cont.)

| Species | *Red List* | Régnier et al., 2009 | This study | Source for revised status; comments |
|---|---|---|---|---|
| *Pleurobema perovatum* (Conrad, 1834) | EX 2000 | – | EX | |
| *Pleurobema troschelianum* (Lea, 1852) | EX 2000 | – | EX | |
| *Pleurobema verum* (Lea, 1861) | EX 2000 | EX | EX | |
| *Quadrula tuberosa* (Lea, 1840) | CR 1996 | EX | EX | Evaluated as *Theliderma tuberosa* by IUCN (2016) |

**Table A5.** Marine species considered extinct (EX) or possibly extinct (EX?) in the present study, compared with their status as evaluated by Régnier et al. (2009), and on the *Red List* (IUCN, 2016). Dashes indicate that the species was not evaluated. A source is only provided for species of Conidae, for which the status in this study differs from that of IUCN (2016) and Régner et al. (2009).

| Species | *Red List* | Régnier et al., 2009 | This study | Source for revised status |
|---|---|---|---|---|
| CONIDAE | | | | |
| *Conasprella sauros* (Garcia, 2006) | DD | – | EX? | Peters et al., 2013 |
| *Conus bellulus* Rolán, 1990 | – | – | EX? | Peters et al., 2013 |
| *Conus colmani* Röckel and Korn, 1990 | DD | – | EX? | Singleton, 2007 |
| LOTTIIDAE | | | | |
| *Lottia alveus* Conrad, 1831 | EX 1994 | EX | EX | |
| NACELLIDAE | | | | |
| *Collisella edmitchelli* Lipps, 1966 | EX 1996 | EX | EX | |
| POTAMIDIDAE | | | | |
| *Cerithideopsis fuscata* (Gould, 1857) | – | EX | EX | |

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